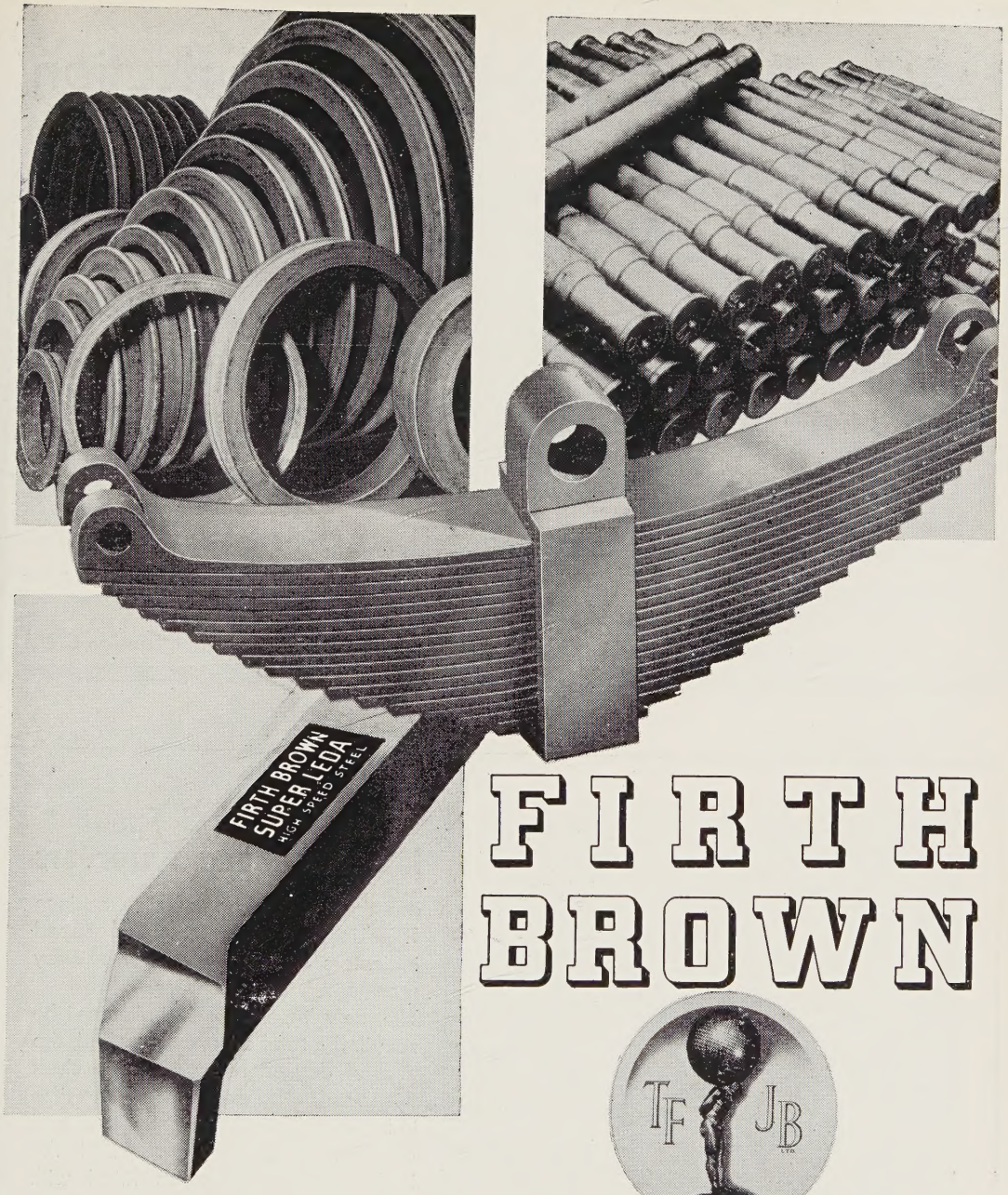
656.06
INT
No. 2

VOL. XXIII. — N° 8.

NOVEMBER 1946

Monthly Bulletin of the International Railway Congress Association

(English Edition)



FIRTH
BROWN

RAILWAY FORGINGS & TOOLS

THOS FIRTH & JOHN BROWN LTD SHEFFIELD

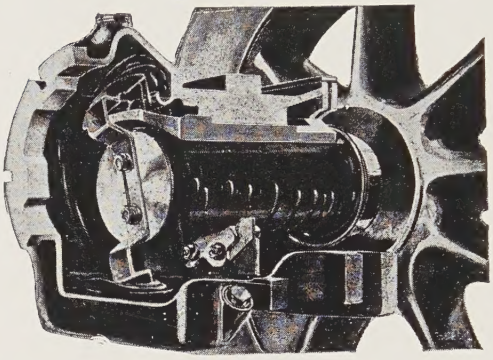
« ISOTHERMOS »

Axle box with mechanical lubrication

Bearing " Athermos "

Complete safety with any loads and at the highest speeds

•



Oil saving

No maintenance

Minimum coefficient of friction

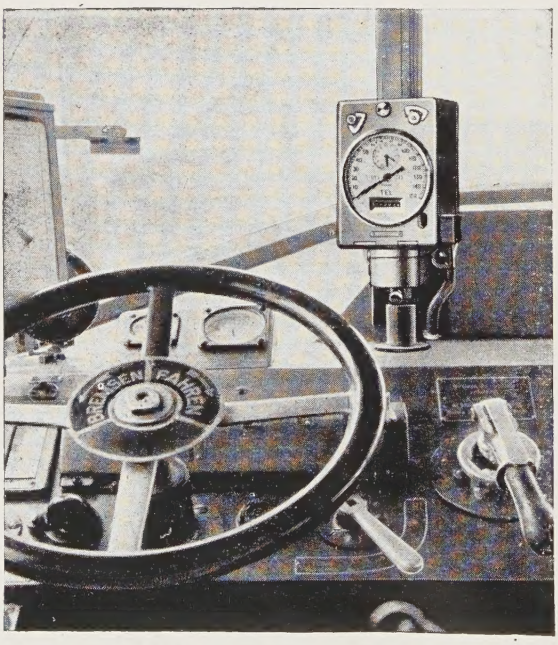
•

Brussels - Société Générale " Isothermos " - Paris

9, rue du Moniteur **35, rue de la Tour d'Auvergne**

Agents or Representatives in all main countries

In Great Britain : J. STONE & Co. Ltd. Oceanic House - 1a, Cockspur Street, London S.W.1



The TELOC Speed Indicators and Recorders

are the product of experience since 1887 in the construction of speed indicators and recorders for railway locomotives and vehicles.

The new type TELOC indicates the speed, the total distance travelled, the time of day. It records on the chart the speed, distance travelled, the time in hours and minutes and the time and duration of stops. If required the instruments can also be fitted with apparatus to record the pressure in the brake pipes, the direction of travel and the passing of signals, etc.

Hasler S.A. Berne

MANUFACTURE D'APPAREILS TÉLÉPHONIQUES ET DE PRÉCISION

FONDÉE EN 1852 TÉLÉPHONE NO. 64

S. A. LA BRUGEOISE et NICAISE & DELCUVE

Steel-works, Forges and Engineering Works

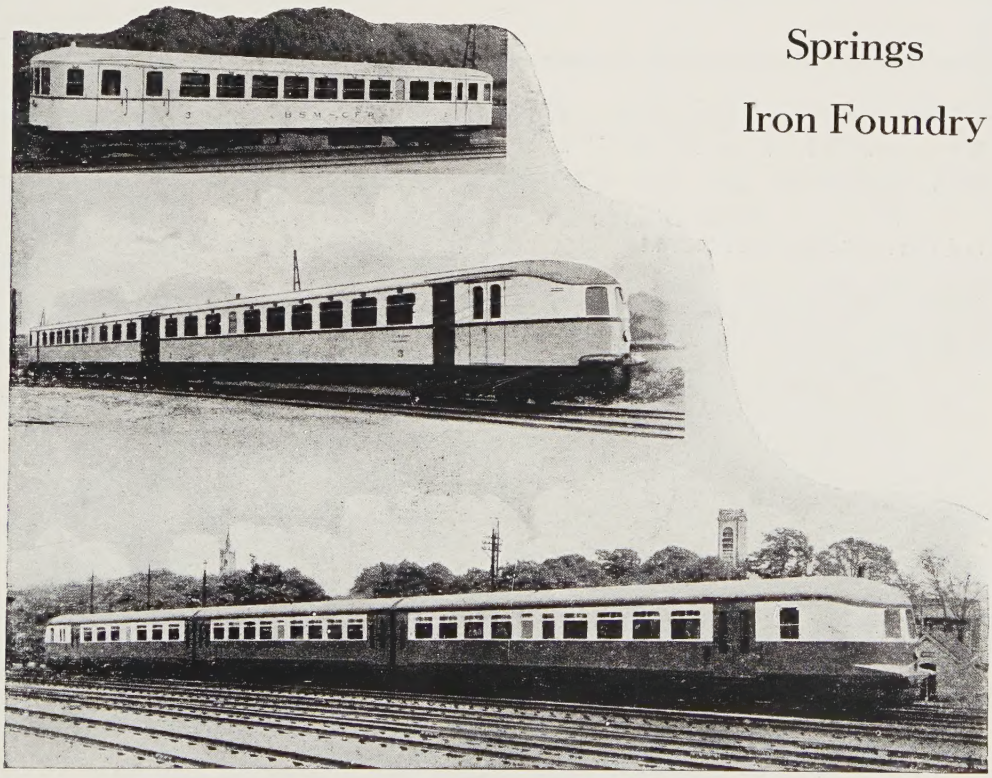
Works at St-Michel near Bruges and at La Louvière (Belgium)
General Management at St-Michel near Bruges

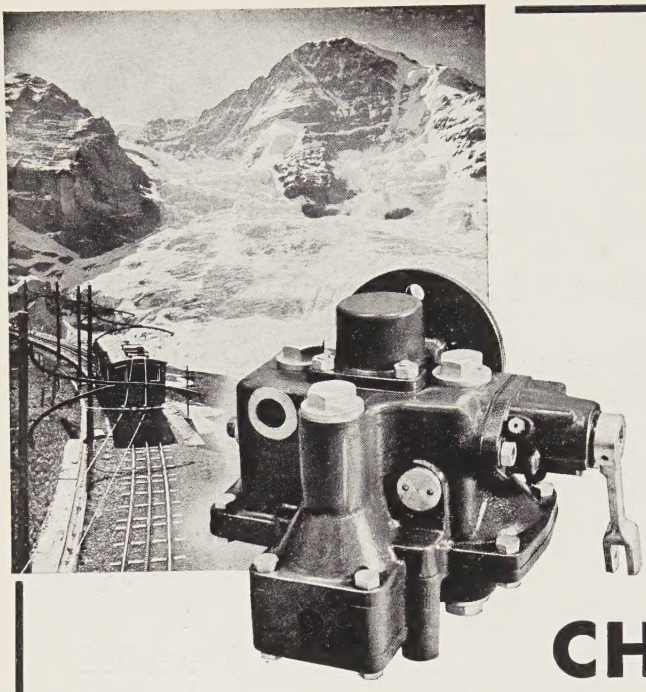
Rolling Stock and Fixed Equipment for Railways and Tramways

Bridges, Frames, Tanks
and all Metallic Constructions riveted and welded
Steel Castings of all kinds and qualities

Springs

Iron Foundry





AIR BRAKES

FOR RAILWAYS AND TRAMWAYS

MULTI-VALVES

DRIVERS BRAKE VALVES

PRESSURE RELAYS

STOPEX automatic slack adjuster for clasp brakes on rolling stock.

TUSTOP brake adjuster for empty-load devices of freight cars.

CHARMILLES

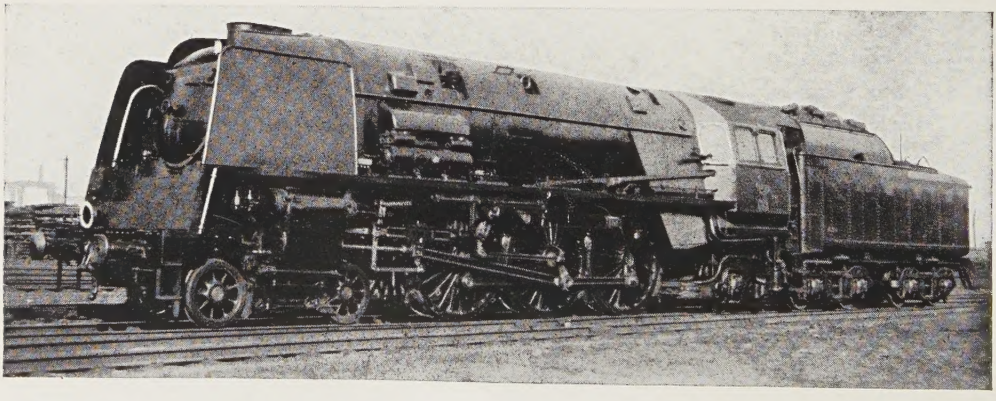
ATELIERS DES CHARMILLES S. A. • GENÈVE

Sᵀᴱ ANGLO-FRANCO-BELGE

DES ATELIERS DE LA CROYERE, SENEFFE ET GODARVILLE

Head Office : LA CROYÈRE (BELGIUM)

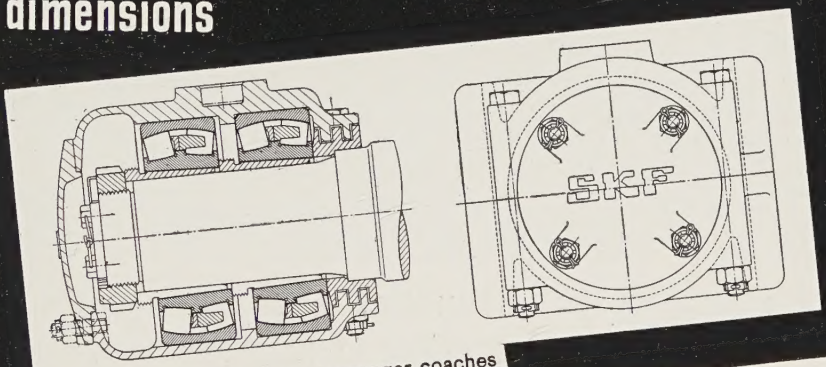
Telegrams : LOCOMORAM-LA CROYÈRE Telephone. 2 lines : LA LOUVIÈRE Nos. 44 and 1229



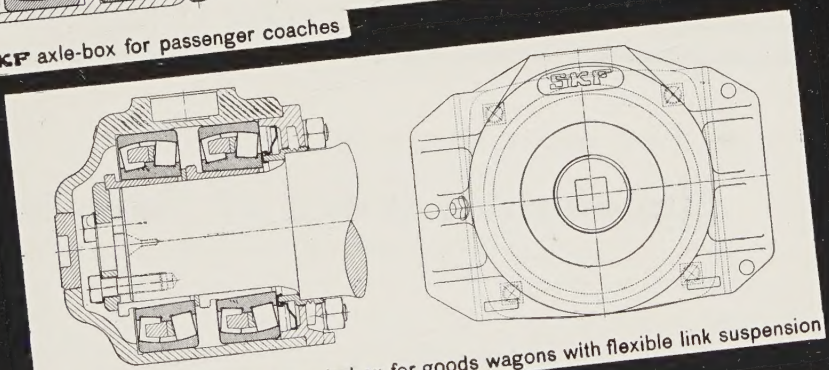
Carriages of every class and description. — Rail motor cars, Steam, electric, heavy-oil petrol and gazolene locomotives. — Ordinary and special waggons. — Caboose Cars and brake vans. — Tenders. — Crossings, switches and track material. — Boiler and plate work. — Heavy forgings. — Press forming. — Wheels and axles.

THE SKF RAILWAY AXLE-BOX

containing two self-aligning roller-bearings can carry a heavier load than any other type of comparable dimensions



Standard SKF axle-box for passenger coaches



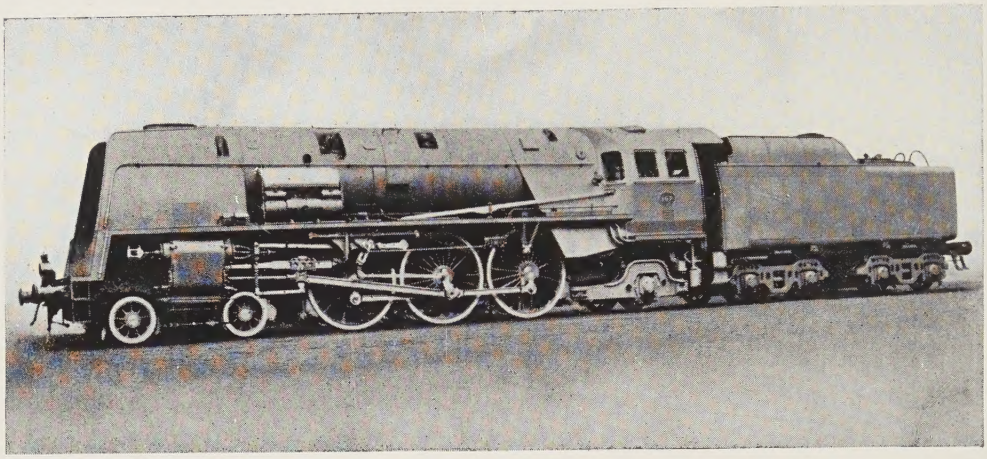
Standard SKF axle-box for goods wagons with flexible link suspension

- SKF self-aligning roller-bearings adapt themselves instantaneously to all misalignment, and combine great radial and axial carrying capacity with low friction
- Thanks to the tapered sleeves, the axle journals suffer no wear or damage in the mounting or dismantling.
- The journals are cylindrical and therefore easy to machine.
- The SKF bearing components are readily separated and reassembled - a valuable aid to inspection and cleaning.

SKF

SOCIÉTÉ BELGE DES ROULEMENTS A BILLES
SOCIÉTÉ ANONYME
117, BOULEVARD ANSPACH BRUXELLES Téléphone : 11.65.12-13-14-15

JOHN COCKERILL S. A. SERAING (Belgium)



METALLURGY

MACHINERY and METAL STRUCTURES
SHIPYARD AT HOBOKEN (ANTWERP)

Alphabetical Index of Advertisers

Firms :		Specialities :
Anglo-Franco-Belge des Ateliers de La Croyère, Seneffe et Godarville (Soc.)	V	Locomotives and Railway rolling stock.
Ateliers des Charmilles (S. A.)	V	Air brakes for railways and tramways.
Brown, Boveri & Co. Ltd.	—	Electric locomotives.
Brugeoise et Nicaise & Delcuve	IV	Railway rolling stock and fixed equipment.
Cockerill (John)	VII	Machinery and metal structures.
English Electric Company, Ltd (The)	—	Railway electrification.
Firth (Thos) & Brown (John), Ltd.	II	Railway forgings and tools.
Hasler (A. G.)	III	Speed indicators and recorders.
Isothermos (Société générale)	III	Axleboxes.
S. A. B. (Svenska Aktiebolaget Broms-regulator)	—	Automatic slack-adjusters.
S. K. F. (Société Belge des Roulements à Billes)	VI	Axleboxes.
Usines Emile Henricot	—	Automatic couplers.

THE LIBRARY OF THE
SEP 23 1947
UNIVERSITY OF ILLINOIS

MONTHLY BULLETIN

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(ENGLISH EDITION)

PUBLISHING and EDITORIAL OFFICES : 19, RUE DU BEAU SITE, BRUSSELS.

Yearly subscription for 1946 : (Belgium . . . . . 525 Belgian Francs
(from April to December) (Other countries . . . 600 Belgian Francs

Price of this single copy : 80 Belgian Francs.

Subscriptions and orders for single copies (January 1931 and later editions) to be addressed to the General Secretary, International Railway Congress Association, 19, rue du Beau Site, Brussels (Belgium).

Orders for copies previous to January 1931 should be addressed to Messrs. Weissenbruch & Co. Ltd., Printers, 49, rue du Poinçon, Brussels.

Advertisements : All communications should be addressed to the Association, **19, rue du Beau Site, Brussels.**

CONTENTS OF THE NUMBER FOR NOVEMBER 1946.

CONTENTS	Page.
I. The new **29 class locomotive** of the Belgian National Railways, by J. VANDERSYPEN	383
II. **Powdered coal** feeds a turbine, by HARLAND MANCHESTER	401
III. **Fluorescent lighting** of railway carriages, by M. DURAND	406
IV. **Locomotives** for today and tomorrow, by C. KERR (Jr.)	412
V. **Seasoning ties** in **hours** instead of months	422
VI. Large **A. S. T. M. meeting** held at Chicago	430
VII. MONTHLY BIBLIOGRAPHY	121

LIBRARY

OF THE

Permanent Commission of the International Railway Congress Association.

READING ROOM : **19, rue du Beau Site, Brussels.**

Works in connection with railway matters, which are presented to the Permanent Commission, are mentioned in the « Bulletin ». They are filed and placed in the library. If the Executive Committee deems it advisable they are made the subject of a special notice. Books and publications placed in the reading room may be consulted by any person in possession of an introduction delivered by a member of the Association. Books, etc., may not be taken away except by special permission of the Executive Committee.

The Permanent Commission of the Association is not responsible for the opinions expressed in the articles published in the Bulletin.

All original articles and papers published in the Bulletin are copyright, except with the consent of the Authors and the Committee.

An edition in French is also published.

VOL. XXIII. — No. 8. November 1946.

BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[621 .132 .3 (.493) & 621 .132 .5 (.493)]

The new 29 class locomotive of the Belgian National Railways,

by Mr. J. VANDERSYPEN,

Chief Engineer, Assistant to the Director of Rolling Stock of the Belgian National Railways.

1. General particulars.

In agreement with the Belgian Government, immediately after the liberation, the Belgian National Railways looked into the question of providing quickly a sufficient pool of locomotives to deal with post-war traffic. It was necessary to take into account that the damaged workshops could not deal speedily enough with the repair of their quota of disabled locomotives. It was also necessary to take into consideration that, in spite of the help of Belgian Industry, the railways would soon find themselves with insufficient locomotives to ensure the traffic and it was decided to get into touch with American Industry, for the construction of 300 locomotives, as they alone could supply quickly.

As U.S.A. workshops could not supply the total of 300 locomotives within the required time, the order was divided as follows :

160 to be built by the « Montreal Locomotive Works », Montreal, Canada.

60 to be built by the « Canadian Locomotive Co. », Kingston, Canada.

80 to be built by the « American Locomotive Co. », Schenectady, U.S.A.

2. Class.

The Belgian National Railways decided to keep to 10 types of steam locomotives for its future stock, of which 4 would be passenger engines, 2 goods, 2 mixed-traffic and 2 shunting.

Amongst these is a 2-8-0 of 75 tonnes (73.8 Engl. tons) adhesive weight, mixed-traffic locomotive capable of attaining 90 km. (56 miles) per hour when drawing heavy, semi-fast or slow passenger trains on difficult track and hauling goods trains of 1 200 tonnes (1 181 Engl. tons) on easy track and 550 tonnes (541 Engl. tons) on difficult lines.

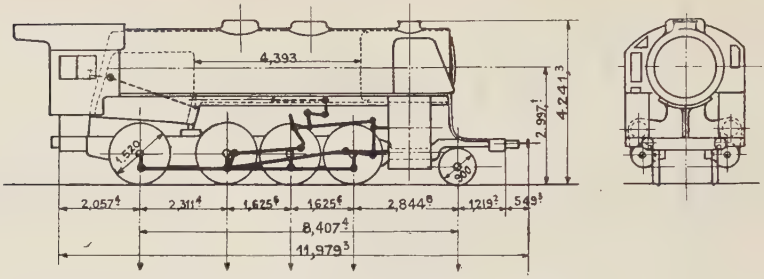
It was decided that the 300 locomotives to be purchased should accord as much as possible with the characteristics of the type described above.

3. General characteristics.

The characteristics finally decided on are shown in fig. 1.

Class 29 Locomotive of the Belgian National Railways.

Quantity : 300 locomotives.



Tonnes	19.479	19.479	19.479	19.479	15.040	Total 92 t. 956 en ordre de marche.
Engl. tons	19.171	19.171	19.171	19.171	14.802	Total 91.486 Engl. tons in working order.

CHARACTERISTICS.

Date of construction : 1945.
Locomotives Nos. 29 001 to 29.300.
Type of locomotive : *Consolidation* 2-8-0.

Motion	Diameter of cylinders (d)		559 mm. (22″)
	Piston stroke (l)		711 mm. (28″)
	Diameter of driving wheels (D)		1.520 m. (59 7/8″)
	Pressure (p)		15.75 kgr./cm² (225 lb. per sq. in.)
Boiler	Type of inner firebox : Welded steel.		
	Grate	Length	2.48 m. (97 1/2″)
		Width	1.780 m. (70 1/4″)
		Area (G)	4.40 m² (43.486 sq. ft.)
	Firebox heating surface		14.680 m² (151.349 sq. ft.)
	Tube arrangement — Small smoke tubes	Diam.	45/50 mm. (49/64″/2″)
		No.	152
		Heating surface	94.93 m² (1 012.78 sq. ft.)
	Tube arrangement — Large smoke tubes	Diam.	128/137 mm. (5 1/32″/5 3/8″)
		No.	40
		Heating surface	71.21 m² (764.4553 sq. ft.)
	Heating surface of arch tubes		1.73 m² (11.520 sq. ft.)
	Total evaporative heating surface (S)		182.55 m² (1964.422 sq. ft.)
	Diam. of superheater elements		30.5/38 mm. (1 13/64″/1 1/2″)
	Superheater element heating surface (S¹)		73 m² (785.767 sq. ft.)
	Boiler barrel	average diam.	1.854 m. (6′ 1 1/32″)
		thickness of plate	19.05 mm. (3/4″)
	Thickness of firebox wrapper		14.30 mm. (36/64″)
	Thickness of inner firebox plates (steel)	top	9.5 mm. (3/8″)
		back, and sides	9.5 mm. (3/8″)
		tubeplate	12.7 mm. (1/2″)
	Thickness of smokebox tubeplate		14.3 mm. (37/64″)
	Capacity of boiler in working order		7.850 m³ (277.22 cu. ft.)
	Volume of steam space		2.800 m³ (98.88 cu. ft.)
	Evaporative surface		10.42 m² (108.076 sq. ft.)
Ratio S/G			41.5
Ratio S¹/S			0.4
Tractive effort $T = \frac{0.65\ p\ d^2\ l}{D}$			15 021 kgr. (33 111 lb.)
Weight of locomotive empty			84.5 t. (83.165 Engl. tons)
Adhesive weight (A)			77.916 t. (76.685 Engl. tons)
Ratio T/A			1/5.18

Fig. 1.

The designing was carried out at Montreal. All the necessary features for service on Belgian lines (gauge, draw-gear, brake and heat couplings, position of driver, Belgian boiler regulations, turntables, hydraulic cranes, signalling, etc.), were incorporated.

Fig. 2 is a photograph of the general arrangement of the locomotive and tender. Fig. 3 gives more details of the mechanism.

4. Boilers.

The boiler has an inner firebox with a round top firebox cover plate and half side firebox of welded steel.

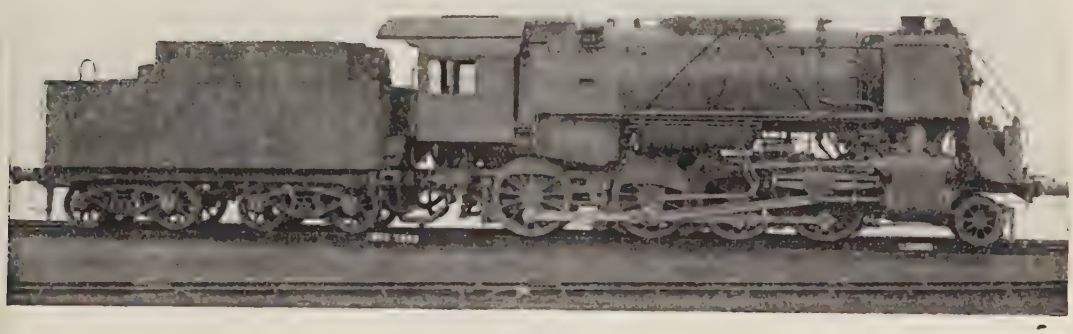


Fig. 2.

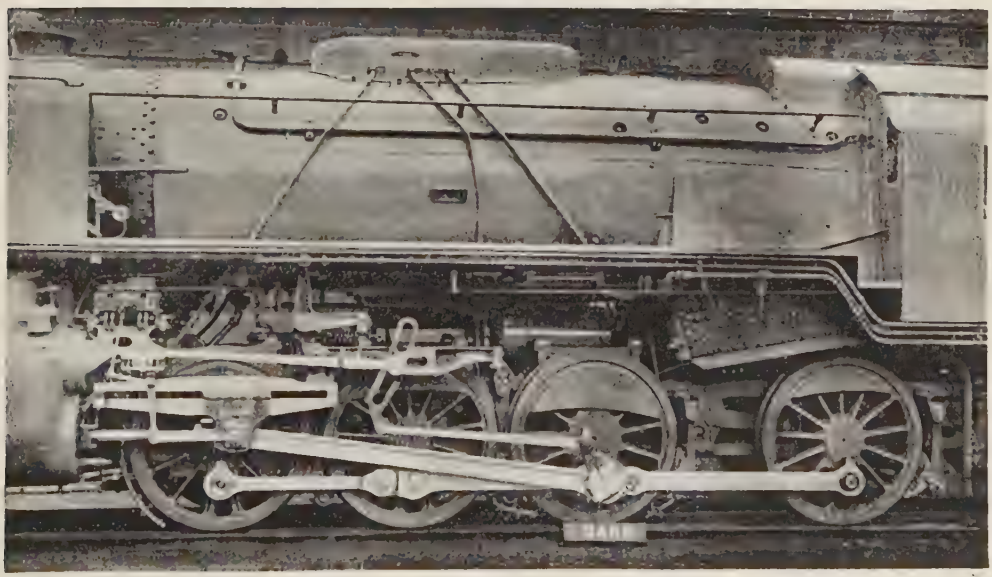


Fig. 3.

Boiler calculations were made in accordance with the conditions laid down by Belgian regulations.

The boiler barrel is of two rings, the factor of safety being 4.75 and 4.85 respectively for the front and back rings.

Fig. 4 shows the double longitudinal butt stays. The butt stays on the 2 barrel plates are not in line but are on opposite sides of the boiler barrel. The efficiency of the front barrel joint is

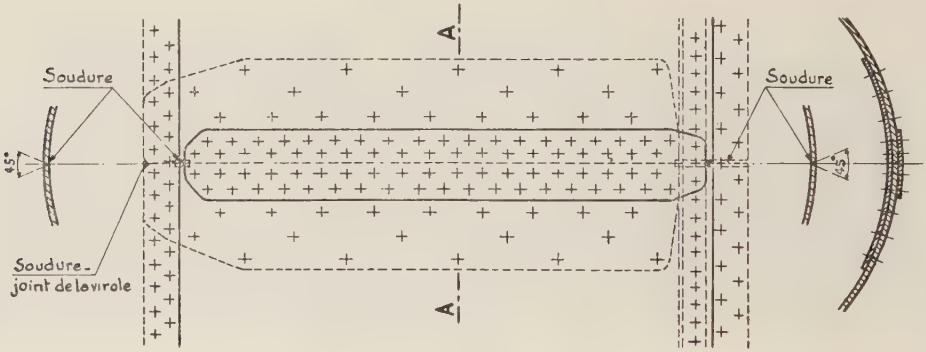


Fig. 4.

Explanation of French terms:
Soudure = welding. — Soudure-joint de la virole = welding of barrel joint.

92.62 % and the back, 92.57 %. By placing the joints on the opposite sides of the barrel the caulking of the outside butt strips is facilitated.

The wrapper plate is calculated to give a minimum factor of safety of 4.5 similar to the boiler barrel.

The inner firebox which is of steel, is made up of three sheets joined by welding. The inner firebox frame is of cast steel. The firebox and inner firebox are rivetted together, and then completed by seal welding. At the firedoor the back plates of the firebox and inner firebox are joined by welding.

The stays are of steel, and are drilled on the fire side to show up stays when fractured. The stays are spaced in accordance with Belgian regulations, which regulations are more stringent than is American practice. Flexible stays are generally used in zones where the plates are considered to have the greatest movement.

The crown of the inner firebox is stayed to the outside plate by means of stay-rods screwed and rivetted, except on the ten central rows which have nuts fitted on the end in the inner firebox. This latter arrangement gives greater security than the former, and can prevent a serious accident in the case of depression of the plate.

The three front tranverse rows of the stay-rods are flexible.

The firebox tubeplate is fitted with palm stays rivetted to the boiler barrel, situated below the tubes and above the water space stays.

At flame level, the water leg is 114 mm. ($4^1/_2''$) in front, and 102 mm. ($4^1/_{64}''$) at the back and sides. The water legs increase progressively towards the top.

The depth of the inner firebox is 0.45 metre ($1'11/_{16}''$) in front, and 0.50 metre ($1'7^{11}/_{16}''$) at the back, which allows a volume of fire of 1.97 m³ (69.57 cu. ft.).

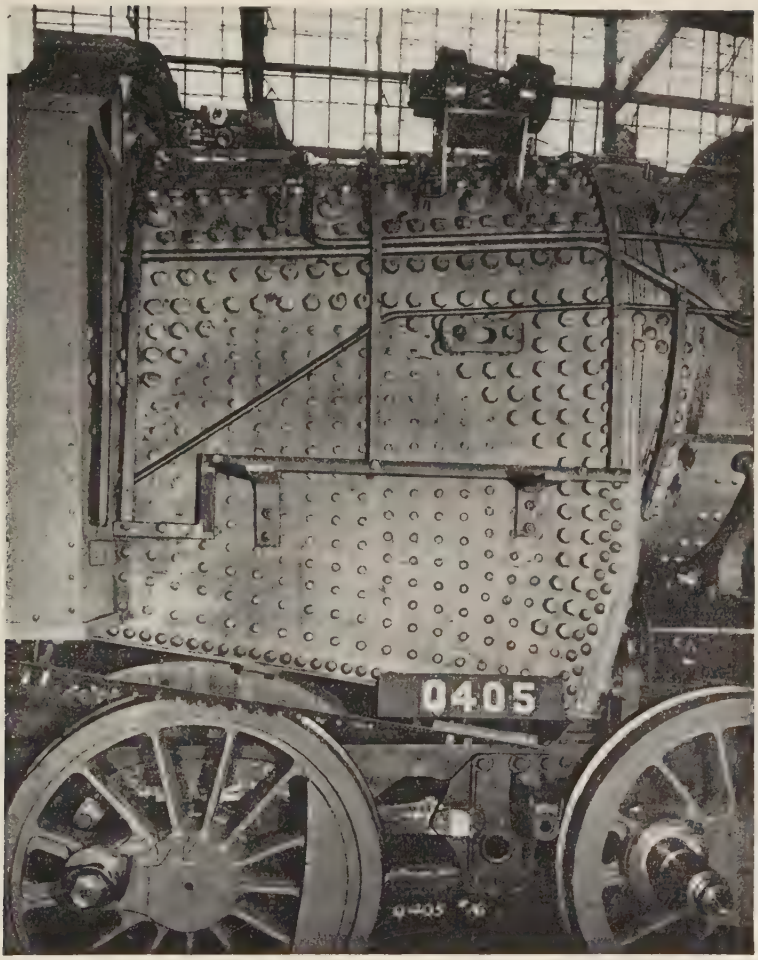


Fig. 5.

The brick arch, which is very long, is supported by three arch tubes. This brick arch allows a high combustion temperature, and protects the firebox tubeplate against sudden cooling due to the opening of the door.

Tubing.

The 40 superheater tubes of 128 × 137 and the 152 smoketubes of 45 × 50 are of steel, and expanded into the tubeplates, being welded at the firebox tubeplate. All the boilers are tested both cold and hot before the tubes are welded to the tubeplate. In this way, there is no excuse for careless expanding on account of the welding.

Smokebox and chimney.

The chimney, which is of cast iron,

has an internal diameter of 419 mm. ($1'4^1/_2''$). The internal arrangement of the smokebox and spark arresters are of the standard American type. This arrangement has proved efficient from the point of view of draught. In addition, the accumulation of ash is avoided. Trials have shown that a run of 100 km. (62 miles) has resulted in 8 kgr. (17 lb.) of ash for class 29, and 80 kgr. (176 lb.) for class 31.

The smokebox door is of the Belgian type, with a central closing arrangement by lever and wheel, and additional fastenings at the smokebox door ring. Fig. 6 is a photograph showing a front view of a locomotive.

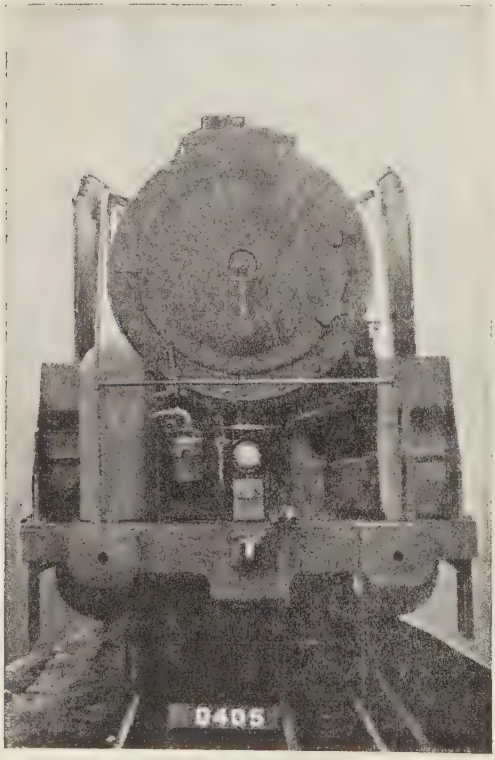


Fig. 6.

Firebox door.

The firebox door is of the « Franklin » type, worked pneumatically by a pedal operated by the fireman (see Fig. 7). On depressing the pedal, the fireman starts the motion of the two half-doors on their axis at the upper portion, thus bringing about an opening. After each shovelful, the fireman releases the pedal, so that the door automatically shuts. In this way, the time that the door is open is reduced to the absolute minimum, which not only decreases the consumption of coal, but prevents damage due to the introduction of too much cold air.

Grate.

A rocking grate is fitted of the Belgian type, arranged to throw the fire out in the front. It has an inclination towards the front of approximately 1/6th.

Ashpan.

The ashpan is of the closed type with door worked from the engine cab or footplate, and outlets for disposing of ash which are operated from the ground.

Superheater.

The superheater is of the Superheater Company's type « A ». Four 30.5 × 38 superheater elements are spaced in each of the 40 large superheater tubes. The element ends are 455 mm. ($1'5^{57}/_{64}''$) from the firebox tubeplate, so that they are in an area where the gas is still very hot. In order to prevent burning of the element end, when steam is not circulating, a valve, placed in the smokebox and worked by the steam pressure in the main steam pipe, suppress the circulation of the gas in the superheater tubes, when the regulator is shut.

Regulator.

The regulator is of equalising valve type and is placed in the dome.

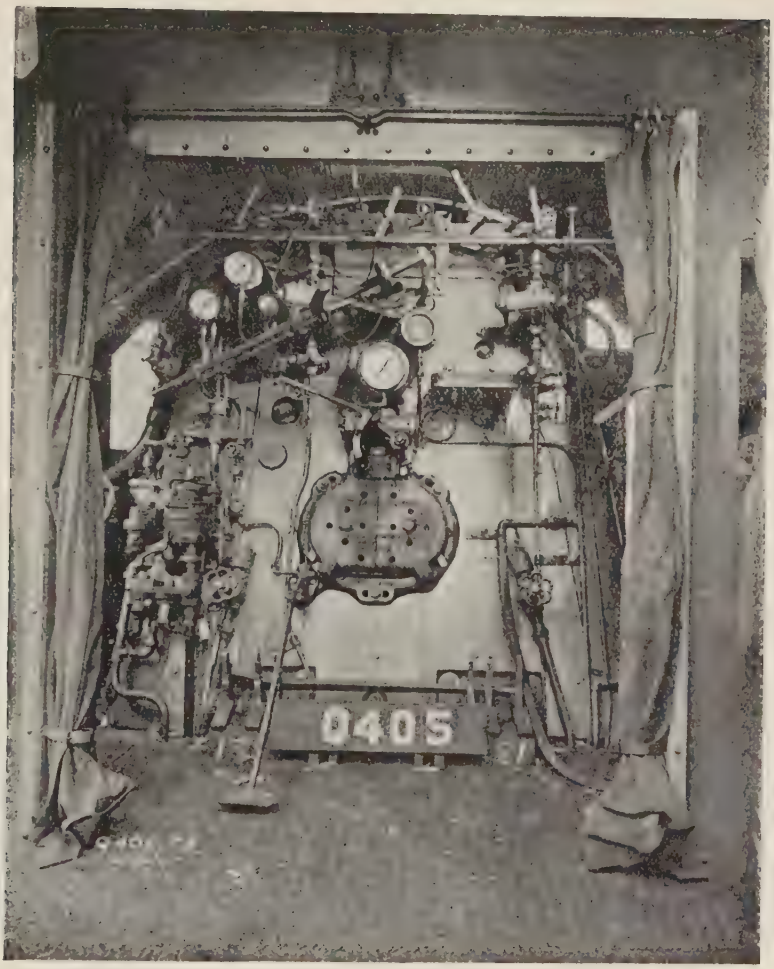


Fig. 7.

Feed water apparatus.

The locomotive has two distinct types of feed water apparatus :

1) Pump equipment with arrangement for reheating the feed water;

2) An injector.

The Worthington type of reheating feed water by mixing is placed in the top of the smokebox. The exhaust steam drawn off the exhaust column enters the reheating chamber by means of a series of retaining valves.

The centrifugal pump, worked by live steam, mixes the cold water, which is sprayed, and reheats it by mixing it with the escaping steam. This reheating also produces a deaeration of feed water.

The hot water descends by gravity towards the pump which is of an alternat-

ing piston type, which pushes it towards the clack valve of the boiler.

A float in the reheater operates on the cold water pump on the entry of the steam, and thus maintains a constant level in the reheating chamber.

The running of the feed water is regulated by a valve which is in the cab, and worked by steam from the hot water pump. A gauge shows the pressure at the exit from the cold water pump, and thus indicates to the staff the condition of the delivery.

The injector is of « Nathan » suction and restarting type, and is placed in the cab. Its priming is made automatic by the simple movement of a lever.

The injector clackvalves and also the pump equipment are mounted on the front portion of the boiler barrel and deliver in the steam space.

Safety devices.

Two Coale type safety valves, with a gauge marked in kgr./cm², two Nathan type indicators, two fusible plugs, two indicator plates showing the lowest permitted level of the water at 100 mm. ($3^{15}/_{16}''$) above the inner firebox crown.

The water level indicators are fitted with wheel valves of the American type, to enable the water level to be tested. A special arrangement is fitted to indicate whether the valves are open or shut.

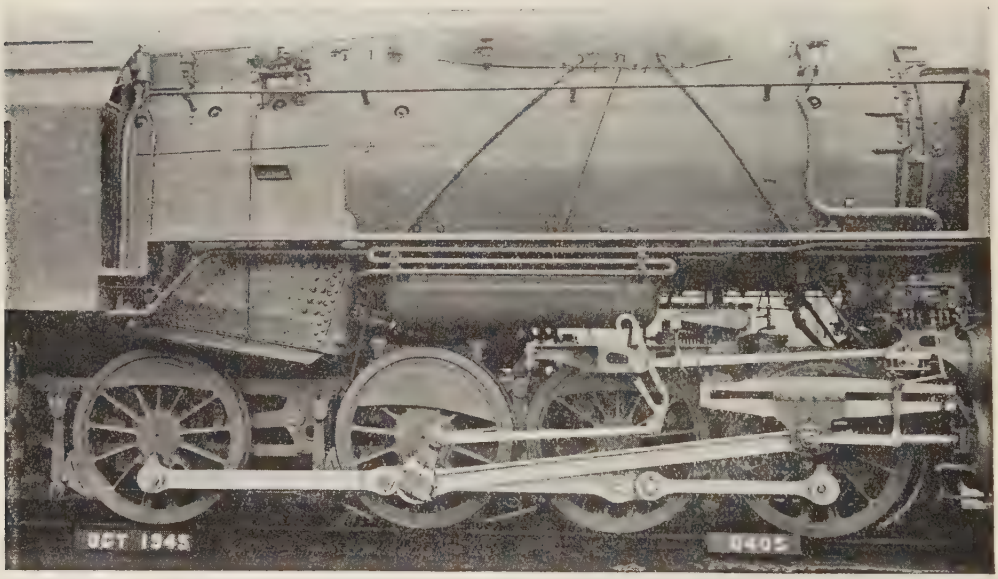


Fig. 8

Accessories.

It is fitted with a Tritone whistle, smokebox blower, divided type washout plugs following Belgian practice, two Everlasting type blow down valves, which can be coupled to the Belgian Railways' Mecheli Shed installations.

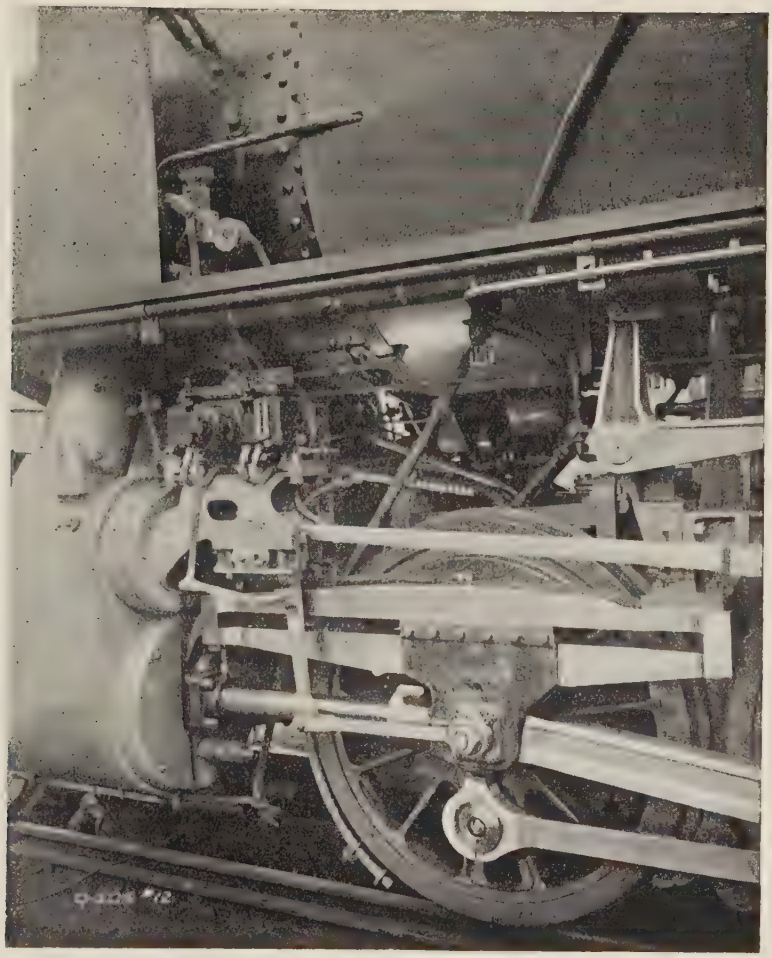


Fig. 9.

Outside casing.

Outside casing plates are of plate 1.2 mm. (0.047 in.) thick with an air space of 50 mm. (1.968 in.) round the boiler barrel. Under the cab, between the boiler and casing, asbestos sheeting has been placed.

5. Motion.

(See Figs. 8 & 9.)

The locomotive has two outside cylinders with inside frames. 220 locomotives have the frames made up of cast steel bars and 80 have similar shape frames cut by burner to the same dimensions, and then heat treated.

Cylinders.

In order that liners can be fitted when the bore becomes too large, the cylinders, which are of cast iron, have walls 50 mm.

($1^{31}/_{32}$") thick. The drain valves are mechanically controlled.

The automatic bypass of the Wota type puts the two sides of the piston in communication when the regulator is closed. This bypass is shown in Figure 10.

The piston valves have a diameter of 304.8 mm. (1'), and the locomotives are fitted with Walschaert's valve gear.

The reversing gear is of the compressed air type known as « Precision Gear » supplied by the Franklin Railway Supply Company.

This gear is shown in Figure 11.

The reversing screw works on a valve admitting air to the front or rear of a piston, which operates the reversing shaft.

Pistons and piston rods.

Contrary to the usual Belgian practice for superheated locomotives, the pistons have no tail rod. The weight of the piston is taken on the rings, but these are of a special Hunt Spiller type shown in Fig. 12.

Ordinary cast iron segments exactly fit the contour of the cylinder and are kept in place by their own elasticity. With the Hunt Spiller segments, the two functions are separate. The segments are half brass and half cast iron. They are sub-divided in rings which can be applied separately against the interior of the cylinder while a steel leaf spring supplies the necessary force.

In order that this spring once in place produces uniform compression over the whole length of its contour, it must, when free, have a definite radius of curvature, and be of accurate dimensions to give the desired result.

« King » type packing is used.

Equalising valve — open.

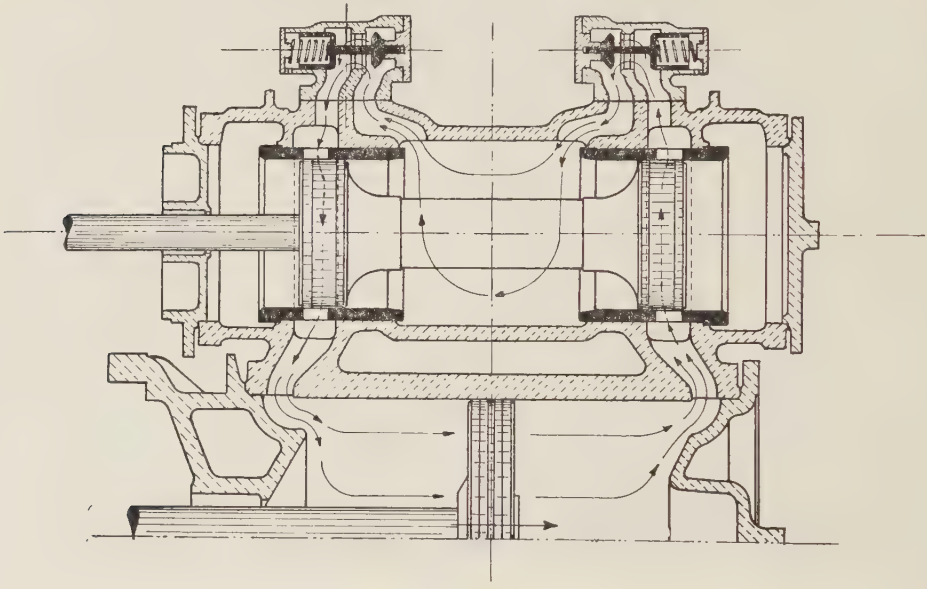


Fig. 10.

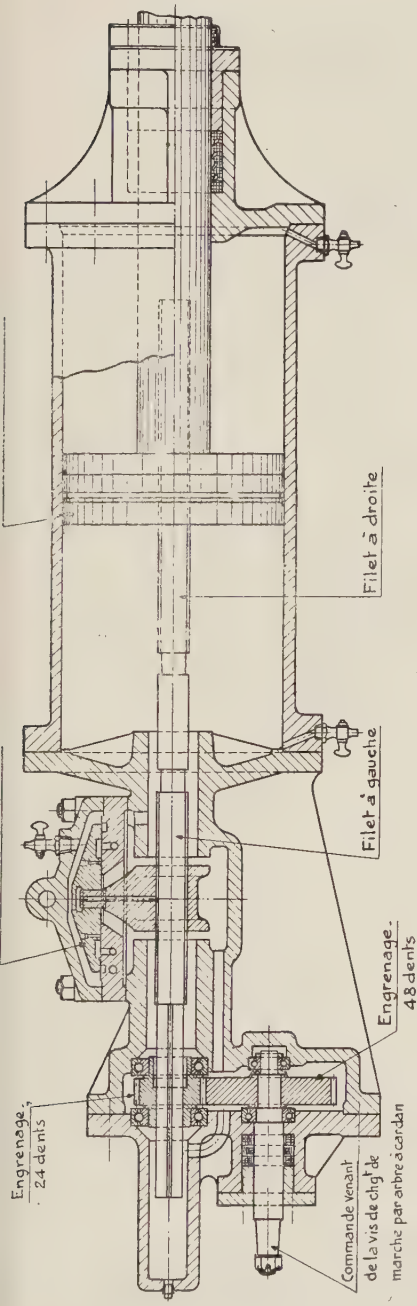

Filet à droite
Filet à gauche
Engrenage. 48 dents
Engrenage. 24 dents
Commande venant de la vis de chgt de marche par arbre à cardan

Fig. 11.

Explanation of French terms:

Engrenage 24 dents = 24-tooth gear. — Tiroir de distribution d'air = main slide valve (air). — Piston du servo-moteur = piston operating reversing gear. — Commande venant de la vis de changement de marche par arbre à cardan = control from reversing screw through cardan shaft. — Engrenage 48 dents = 48-tooth gear. — Filet à gauche = left spindle. — Filet à droite = right spindle.

Crossheads and guides.

Lairds.

Connecting and coupling rods.

The connecting rods are of double tee section with solid lead end. The coupling rods are of rectangular section. Bronze bushes filled with whitemetal are fitted by hydraulic pressure.

Balancing.

The reciprocating masses are large — 532 kgr. (1 172 lb.) per cylinder. In addition to the whole of the revolving masses, the counterbalance includes 33 % of the reciprocating masses. At a speed of 96 km. (60 miles) per hour, the counterbalance of the reciprocating masses gives a hammer blow of two tonnes (2.204 Engl. tons) per wheel.

All the moving parts are calculated to allow for the inertia forces which develop at this same speed of 96 km. per hour, the maximum speed for which the locomotive was constructed, and which it easily attains This speed is also the American diameter speed, i.e., as many m.p.h. as there are inches in the diameter of the driving wheels.

Lubrication.

Oil lubrication.

The rods are fitted with Belgian pin type lubricator.

Two mechanical lubricators are placed on the rear covers of the cylinders. The L.H. lubricator discharges cylinder oil at 14 points to the cylinders and slide valves, and the R.H. lubricator discharges « engine oil » at 14 points to the boxes and crosshead guides.

The lubrication of the slide valves is carried out by vaporising the oil in the delivery pipes, the oil being spread on a ledge and drawn along by the steam draught.

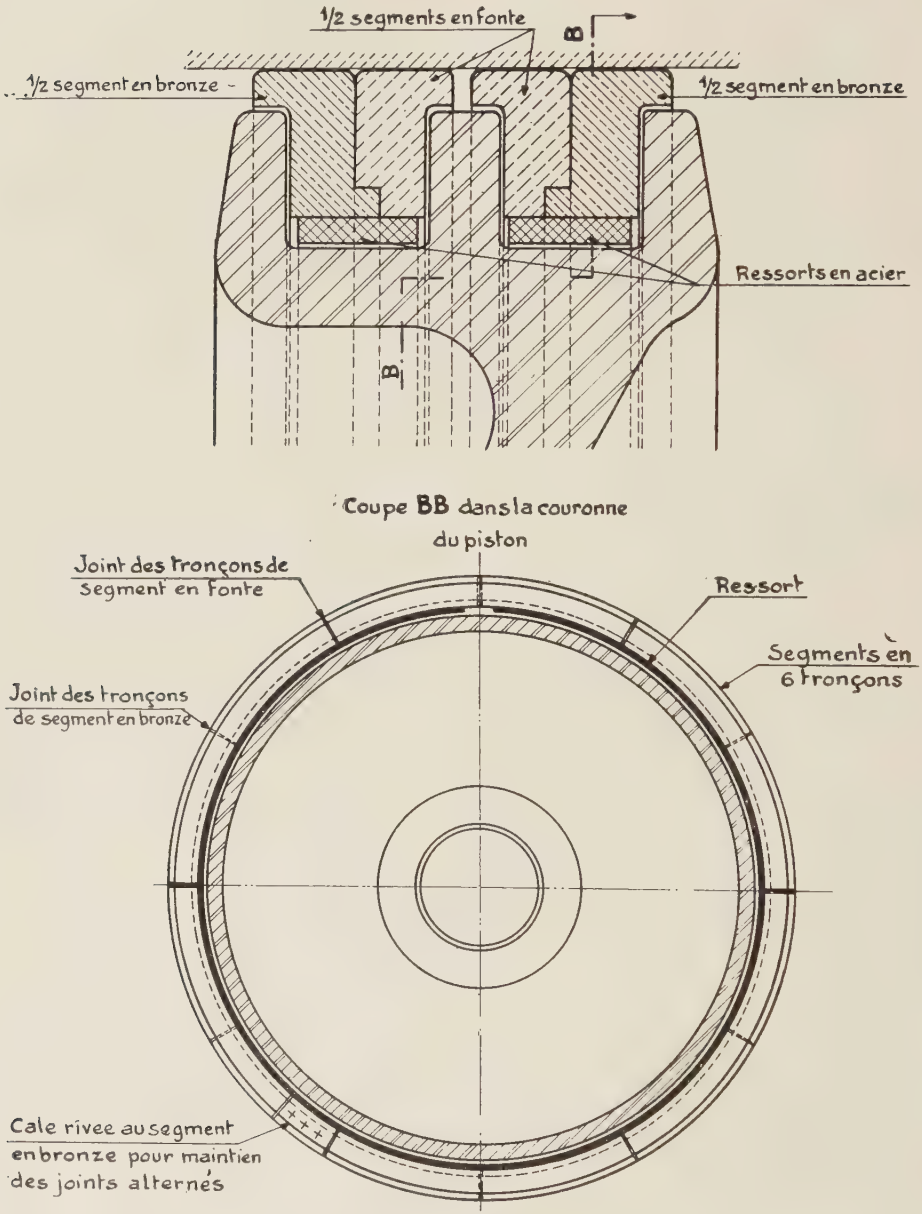

1/2 segments en fonte
B
1/2 segment en bronze
1/2 segment en bronze
Ressorts en acier
B
Coupe BB dans la couronne du piston
Joint des tronçons de segment en fonte
Ressort
Segments en 6 tronçons
Joint des tronçons de segment en bronze
Cale rivee au segment en bronze pour maintien des joints alternés

Fig. 12.

Explanation of French terms:

1/2 segments en fonte = cast iron half segments. — 1/2 segment en brone = bronze half segment. — Ressorts en acier = steel springs. — Coupe BB dans la couronne du piston = section BB to show rings in piston. — Joint des tronçons de segment en fonte = joint of the pieces of the cast iron segment. — Joint des tronçons de segment en bronze = joint of the pieces of the bronze segment. — Cale rivée au segment en bronze pour maintien des joints alternés = rivetted bronze liner to maintain alternate joints. — Ressort = spring. — Segments en 6 tronçons = segments in 6 pieces.

A sight feed lubricator placed under the canopy lubricates the Westinghouse pump.

6. The underframe.

Suspension.

« Three point » type suspension is used, that is to say the suspended weight is distributed amongst the three sets of wheels and in each the load is distributed proportionately between the wheels concerned by bringing levers into play.

First group : Bissel truck and two first coupled wheels, left and right sides.

Second group : Third and fourth driving wheels left side.

Third group : Third and fourth driving wheels right side.

The springs above the boxes take the load at their ends by means of spring hangers brought into play either directly by the underframe or through the use of equalisers. The exception to the above is the fourth driving axle where, owing to the position of the firebox, there is insufficient space to place the spring above the box. This spring is placed to the side and connected to the box by equaliser.

The springs are of silico-manganese steel.

Axles, wheels, axleboxes.

The wheel centres are of cast steel and are pressed on the axles by hydraulic press. The tyres are put on hot, and the contraction on cooling, gives the required grip. The rims and spokes are designed so that ultimately it will be possible to attach the tyres by means of the «Verein» attachment which is the Belgian standard.

The tyres flanges of the front and rear driving wheels have the normal full profile but those of the second and third driving wheels are thinner in accordance with the standard Belgian profile.

By means of the above arrangement, the locomotive can work round 175 m. (574 ft.) curves without widening the rails, 125 m. (410 ft.) with a widening of 10 mm. ($^3/_8$″) and 97 m. (318 ft.) curves with a widening of 20 mm. ($^{13}/_{16}$″).

The boxes are of cast steel with bronze inserts. The inserts are of bronze and faced with whitemetal and are a tight fit in the box. The guides and adjusting wedges are of cast iron.

Bissel truck.

The bissel truck has triangular hanger suspension which ensures an initial controlling force of 2 700 kgr. (5 952 lb.). This relatively large force ensures a good reaction against « hunting » and assists in keeping the locomotive on the track.

In a 500 m. (1 640 ft. 5 in.) radius curve the controlling force reaches approximately 3 700 kgr. (8 157 lb.).

Fig. 13 is a diagram showing how the centre of friction is arrived at, and the reactions of rail-wheel friction which would exist if the locomotive did not have a bissel truck. (For the formula of this graphical method of determining the friction see *Technisch Wetenschappelijk Tijdschrift*, No. 4 of 1944.) The reaction of the rail on the flange of the first outer wheel would be in the neighbourhood of 11 tonnes (10.826 Engl. tons) for a coefficient of friction of 0.25.

By the addition of the bissel truck (Fig. 14) the centre of friction is noticeably brought forward. The reaction of the rail on the flange is reduced to 5 tonnes (4.921 Engl. tons) and the average friction radius is appreciably lowered thus reducing resistance when working round a curve.

The tail of the bissel truck has been

made shorter than necessary, so that the carrying axle has a radial position. Due to this fact, the bissel truck inclines towards the inside of the curve, throwing its own centre of friction in front which also directs the recoil of the rail wheel

Draw and buffing gear.

The draw and buffing gear on the front of the engine and on the back of the tender are of the Belgian type.

Coupling between the engine and ten-

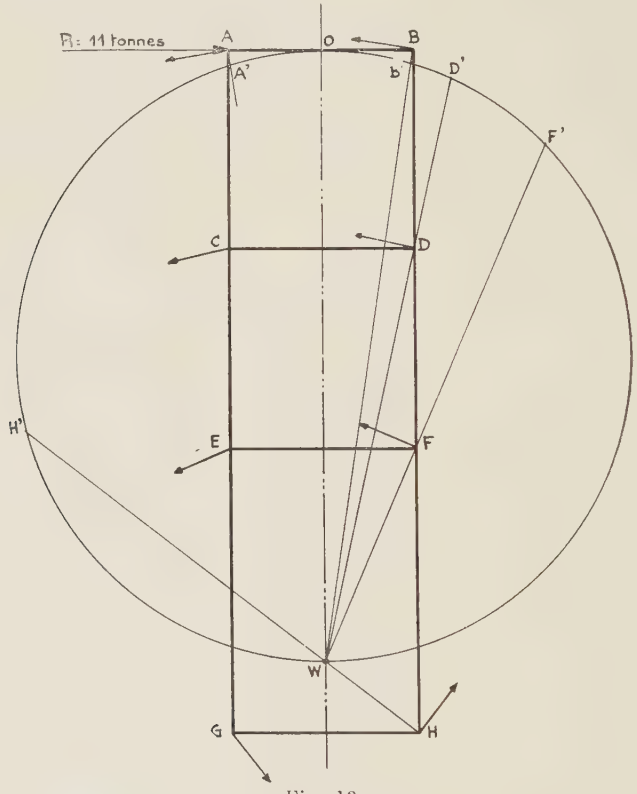


Fig. 13.

friction of the bissel truck towards the inside of the curve, in the opposite direction to the trailing force exerted on the bissel truck by the locomotive. These forces partially equalise themselves, leaving very little as a recoiling action of the rail on the tyre flange. The chances of derailment of the bissel truck on the one hand and on the first driving wheel on the other are thus greatly reduced.

der is carried out by a special gear of the Franklin Railway Supply Co., which is used extensively on the other side of the Atlantic. This coupling gear is shown on Fig. 15.

It consists of two plates, one of cylindrical shape mounted on the tender, and the other a spherical shape mounted on the locomotive, between which a thimble

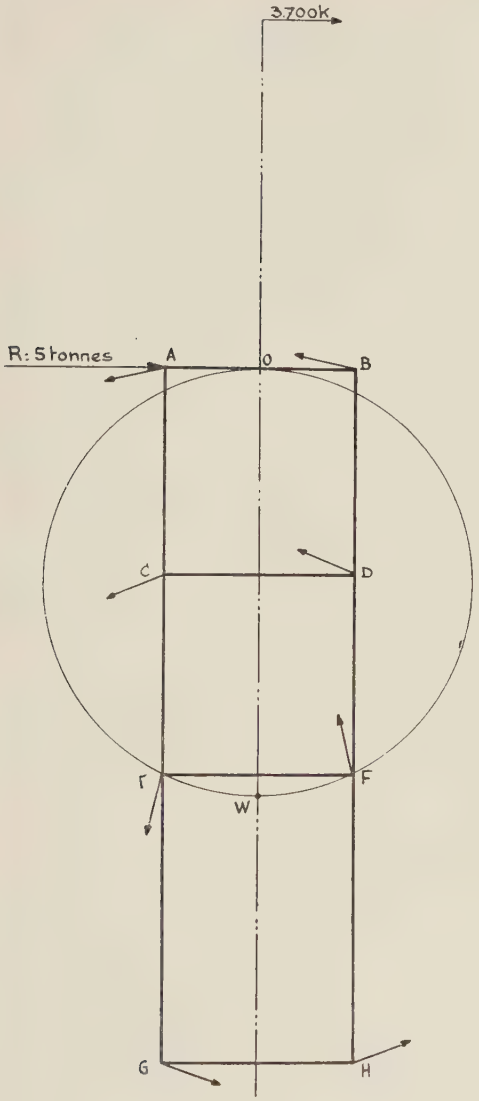


Fig. 14.

of an adequate size can move freely according to the movements of the locomotive and tender.

A rigid drawbar maintains contact with a safety bar in case the first should fail.

7. Braking, heating and lighting.

Brakes.

Westinghouse 6 E T equipment. This equipment combines the automatic braking of the whole train with direct braking of the locomotive only. With its two valves under the driver's control, numerous combinations are possible such as : simultaneous brakeage of the train and the locomotive, stopping of the train only, stopping of the locomotive only, feeding of the auxiliary reservoirs of the train whilst the locomotive is braked, etc. As in the Belgian direct brake, the braking of the locomotive is graduable when being released, as well as when being applied.

Sanding gear.

Sand boxes on the top of the boiler barrel. The sanding gear worked by compressed air distributes sand in front of the first and third pairs of driving wheels when working forward, and in front of the third pair of driving wheels when in reverse.

Steam heating.

Steam heating pipes, steam feed, regulating valve, gauge, and safety valves.

Electric equipment.

Pyle National. Electric head lamps front and rear, together with disc carriers of the normal S.N.C.B. type. Lighting of the cab, front and also motion.

8. Tender.

The tender has two bogies. The tender underframe is cast in one piece of cast steel. The capacity of the tender is 25 cubic metres (883 cu. ft.) of water and 10 tonnes (9.842 Engl. tons) of fuel. The cover of the filling hole can be worked from the ground from either side of

the tender by an arrangement of rod levers.

The tender is provided with the «Ajax» type hand brake, having gears and ratchets.

9. Cab.

The locomotive is arranged for left hand drive as the signals in Belgium are on the left of the track, facing the engine.

signed a tip-up seat allowing the driver to sit, at the same time having easily accessible all the necessary levers : regulator, reversing gear lever, brake valve, sanding gear, drain valves, etc. As, however, we do not wish to force the driver to assume a sitting position, we have made the necessary arrangements so that he can easily drive the engine when standing upright. Visibility is as good in either one or other position. The

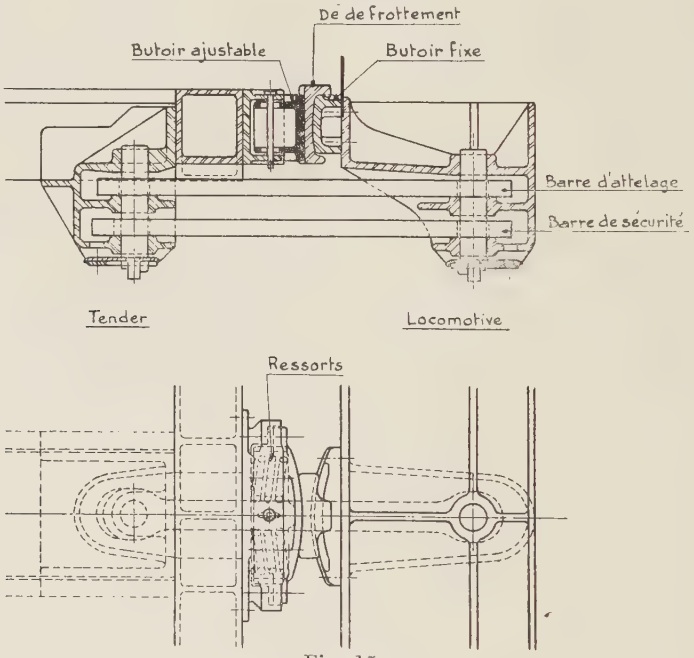


Fig. 15.

Explanation of French terms :

Butoir ajustable = adjustable stop. — Dé de frottement = distance piece. — Butoir fixe = fixed stop. — Barre d'attelage = drawbar. — Barre de sécurité = safety bar. — Ressorts = springs.

Due to the portion of the reversing lever calling for fairly considerable force, and also the position of the regulator handle, the crew usually remain standing whilst on duty on Belgian railways.

The arrangement of the reversing gear described above only calls for the minimum of effort. We have therefore de-

smoke screens stop the smoke beating on the cab.

On the fireman's side we have avoided the obscuring of visibility by the large Westinghouse pump which is often mounted in the fireman's field of vision. This pump has been placed in front of the smokebox, but nevertheless is still

easy of access. A tip-up seat has also been arranged for the fireman.

The cab is partially closed at the rear, protecting the crew from the weather. During long waits in winter, a curtain allows the cab to be completely shut. During the summer, on the other hand, a ventilator has been arranged in the roof of the cab, and large sliding windows with upholstered armrests, which can be placed in the doorway in the open position, increase the crew's comfort.

10. Transport.

Because of the difficulties of transport by sea, the Canadian locomotives were, after trial partially demounted and put in cases. Fig. 16 shows one phase of embarking the first locomotive at Montreal.

The work of assembling them at Antwerp took about 1 000 hours. No difficulty was encountred in this matter.

The 80 American locomotives on the other hand, came ready assembled and were loaded and discharged by means of a special swingle tree.

Fig. 16.

11. Results obtained.

100 locomotives are in service and have run 480 000 km. (300 000 miles). They have been worked on passenger and goods trains for which they were designed, easily hauling the maximum load specified, and keeping good time.

They keep to the track remarkably well up to their maximum speed — recoil and hunting are imperceptible.

Steaming is very good and the fireman has had no difficulty in maintaining the pressure and water level are near the maximum, even when the locomotive works at maximum power. During trials, the first locomotive gave the following results :

Pressure	Pressure easily maintained.
Fall of pressure at admission	Did not exceed 1 kgr. per cm² (14.2228 lb. per sq. in.).
Back-pressure at exhaust	0.5 kgr. per cm² (7.1114 lb. per sq. in.) maximum.
Vacuum in smokebox	Norm. 100-150 mm. ($3^{15}/_{16}''/5^{29}/_{32}''$) water.
Steam temperature	Normally 370-380°.
Tractive effort at the wheel rim	14 000 kgr. (30 864 lb.) at 20 km. (12.42 miles) per hour.
Drawbar pull at 96 km. (60 miles) p. h.	1 400 h.p.

Coal consumption.

The gross consumption par h.p./hour at the drawbar was 2.02 kgr. (4.453 lb.) for goods service Schaerbeek-Libramont and back and of 1.95 kgr. (4.297 lb.) for passenger service Schaerbeek-Ans and back. Taking into account the degree of humidity and the calorific value of the coal burnt, these consumptions correspond to 1.88 kgr. (4.132 lb.) and 1.78 kgr. (3.923 lb.) respectively of coal having a calorific value of 7 500.

The net corresponding consumptions have been calculated in the conditions shown as follows :

1) Temperature of water of the boiler when loaded and at the end of the trial : 10 degrees;

2) Temperature of water in the tender : 10 degrees;

3) State of air consumed, dry at a temperature of 10 degrees;

4) No damping of fuel;

5) The fire was kept in such a manner that the valves did not blow off.

Under these conditions, the consumptions by h.p/hour at the drawbar were 1.35 kgr. (2.975 lb.) and 1.50 kgr. (3.306 lb.) respectively, with coal having a calorific value of 7 500.

Water consumption.

The consumption of water, deduction made for the water lost through the safety valves, and also the water for damping the fuel, was 9.4 kgr. (20.720 lb.) per h.p./hour for goods trains on the Libramont service and 13.4 kgr. (29.54 lb.) for the slow passenger train between Schaerbeek-Ans and back.

It should be noted that a through goods service uses more effectively the reheating installation of feed water which returns a portion of the escaping steam to the boiler, as compared with a slow passenger service. This is one of the explanations of the considerable difference in the consumption of water during the two trials.

* * *

Although steam locomotives have been in existence for more than a century, the envisaged performances of a new locomotive are always surrounded by a certain degree of uncertainity. In the present case, where an existing type of average performance is in question, this degree of uncertainty is less, but it nevertheless exists. It is for this reason that no railway, unless it is forced by circumstances, would build an important class of locomotive without having first constructed a prototype.

We however, were so pressed in the matter that we could not take this precaution. Fortune favoured us, however, as the results shown above can be considered very satisfactory.

We are indebted to the assistance of our many American and Canadian friends, who by their knowledge, experience and kindness have ensured the success of this enterprise. We should like to thank particularly Messrs. W. Twonsend and A. Ross, Director and Chief Designer respectively of the Montreal Locomotive Works, but the many others who assisted us are not forgotten, and we wish to tender to them our grateful thanks.

[621 .132 8 (.73) & 621 .438 (.73)]

Powdered coal feeds a turbine,

by Harland MANCHESTER,

(*Scientific American.*)

For 50 years some of the world's leading inventors have been dreaming of feeding an internal combustion engine with cheap and abundant coal instead of gasoline or oil. Rudolph Diesel planned to run his now famous engine on powdered coal. He couldn't make it work and a number of later attempts, aimed at the same end, were abandoned. The coal was hard to feed and the gritty ash damaged the engines. Still it remained a shining hope for ambitious engineers, who foresaw an industrial revolution if they could wrest power directly from inexpensive coal instead of burning it less efficiently beneath a boiler to make steam.

Now it has been done. In the basement of a laboratory at Johns Hopkins University in Baltimore the world's first successful powdered-coal turbine has been whirring away since last December. Cheap bituminous coal goes in at one end. It is reduced to the fineness of confectionner's sugar by an ingenious but simple mechanism and shot directly into a roaring combustion chamber. Purged of the abrasive ash particles by a man-made whirlwind, the super-hot gases of combustion spin the blades of a turbine.

This pioneer machine is a sprawling affair. It was not built for beauty, but to prove a principle. That principle has now been proved, and work has already begun on a compact, streamlined successor to be mounted in a locomotive. Half a dozen of the country's leading railroads and three major coal companies are gambling on its future, and it now appears that the coal-burning gas turbine will soon be challenging Diesel and steam power not only on the rails but in ships and stationary powerplants as well.

The ultimate importance of an engine that will take coal and make it perform like oil can hardly be over-estimated. It is an accepted fact that our oil reserves are vanishing; the price of oil seems certain to rise over the years as wells go deeper and oil searching goes farther afield. Eventual exhaustion of our oil reserves is inevitable. But we have plenty of coal — enough to last 3 000 years at least. Gasoline and Diesel oil can be made from it by costly chemical processes, but it is obviously cheaper to burn the coal directly.

Steam engines inefficient.

Only 18 months ago, the coal-burning gas turbine — or something like it — was a mere gleam in the eyes of a group of railroad and coal company executives, spark-plugged by Roy B. White, president of the « Baltimore and Ohio ». The group met to consider a common problem. Railroads get an important slice of their income from carrying coal, so it is to their interest to promote its use. But most coal-burning steam locomotives are inefficient in many respects. They convert less than 8 percent of the coal's heat units into power, they waste time taking on water, they jerk passengers when they start, they pound the roadbeds, and they spray the countryside with smoke and cinders. The highly efficient, smooth-starting, oil-burning Diesel has for several years

been pushing the old iron horse out of the picture.

« What this country needs », said Mr. White, « is a better coal-burning locomotive, but it will take plenty of money and one of the best men in the country to build it. » So they passed the hat.

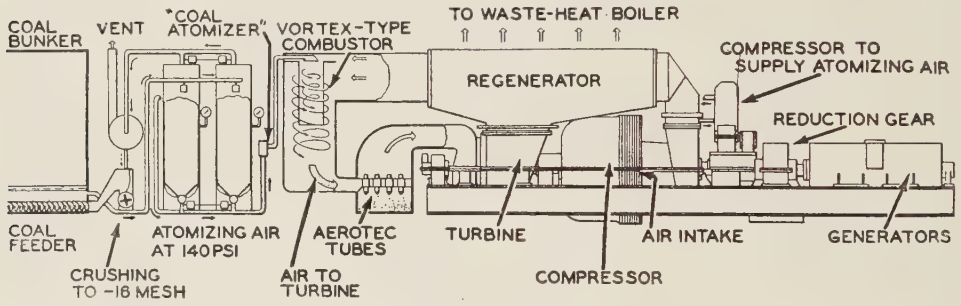
The presidents of the « Baltimore and Ohio », the « Chesapeake and Ohio », the « Louisville and Nashville », the « New York Central », the « Pennsylvania », the « Norfolk and Western » railroads and of the « M. A. Hanna », « Island Creek », and « Sinclair » coal mining companies, joined with « Bituminous Coal Research, Inc. », to raise a million dollars and to form the Locomotive Development Committee. Mr. White was selected as chairman and he set out to find the man to do the job.

The man was found in John I. Yellot, brilliant Johns Hopkins graduate who at 32 became head of the department of mechanical engineering at Illinois Institute of Technology, and who in 1939 was be-medaled by the American Society of Mechanical Engineers as the outstanding young man in his field. Later he became chief of the noted Institute of Gas Technology in Chicago. There he plunged into experiments with gas turbines, and also directed the war training of 55 000 technicians in the fields of explosives, ordnance, aircraft engines, and radar.

Man with ideas.

Yellott jumped at the exciting new commission, and left for Baltimore about a year ago to begin work. He knew about where he was headed, for he had already designed one of the most important parts for such an engine and applied for patents. He was prepared to spend five years translating his ideas into metal and fire, but he had his turbine running before Christmas.

Yellott's coal-burning gas turbine is a close relative of the jet-propulsion plane which has been shattering speed records for the last three years, and of the turbo-supercharger which enables bomber engines to breathe at high altitudes by using the power of the exhaust gases to pack more air into their carburetors.

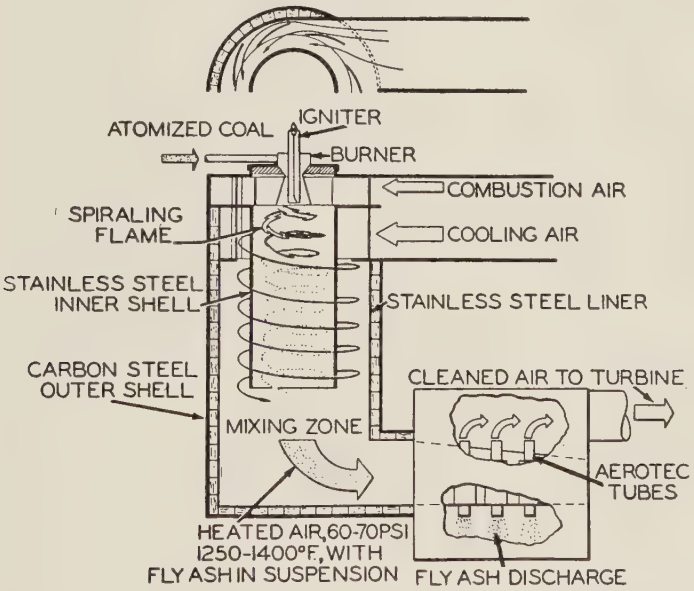


How the coal-burning gas turbine will be set up for locomotive service.

In the jet plane, a fanlike compressor forces air through a combustion chamber where fuel is burned. The flaming hurricane turns a turbine — a super windmill — which runs the compressor, and with its remaining power streaks out through the jet and drives the plane forward. In the gas turbine — as contrasted with the jet — all the hurricane's strength is expended upon the turbine, which, after running the compressor, delivers a husky dividend of useful power for driving generators or turning wheels. The hot gases which do the work don't care what fuel heats them, as long as it has enough energy in it.

Various grades of gasoline and kerosine have been used as fuel for the gas turbine, but many engineers have been lured by the goal of cheap coal. Experiments to this end are being quietly conducted both here and abroad. But Yellott is the first to solve enough of the problems to produce a turbine that really works and can be put into production.

At Johns Hopkins, where the new engine stands in a rectangular space about the size of a locomotive, Yellott traced its operation for me all the way from the coal bunker to the spinning turbine. It is not so much an invention, he says, as a putting together of devices already invented to create something new.



Details of the coal-burning turbine's combustor and fly-ash eliminator.

« Atomized » coal.

Soft coal in the bunker is slowly fed into a preliminary crusher which reduces it to the size of percolator coffee. This is still too coarse for the turbine, so it is « atomized » in a cylindrical device invented by Mr. Yellott while he was still teaching in Chicago. This atomizer works something like the machine used by cereal manufacturers to make « food shot from guns ». The « percolator-size » coal is blown at high pressure through a nozzle, where the air pressure is suddenly released. The air trapped in the pores of the coal tries to get out quickly; the result is millions of tiny explosions which blow the coal particles into smithereens of microscopic size.

« Atomized » coal is a soft, fluffy powder which feels like lamp-black or instant coffee when you rub it between your fingers. It is now so fine that it will burn like fuel oil, when blown into the combustion chamber, creating the raging inferno which a gas turbine demands. This powdering of the coal, by the way, uses up only about 2 percent of the power produced.

Ever since the first inventor thought

of feeding fine coal to an engine in place of oil, the big question has been : How do you get rid of the ashes? If the « fly-ash » — the tiny cinders which remain when powdered coal is burned — were allowed to pelt the whirling turbine blades, the resulting abrasion would cut through them the way a sand-blasting machine cuts stone or brick. In the many attempts to run a Diesel on powdered coal, the ash has always scored the cylinders; even the hardest metals were unable to resist the harsh particles.

Ash precipitated.

Yellott solved the fly-ash problem by removing the dust particles before they hit the blades. The Aerotec dust precipitator, a war-time invention used in tanks, trucks, and airplanes, does the job. During the early fighting in Libya, engines wore out rapidly because fine particles of sand were pulled into them through the air intakes. The problem was turned over to the « Prat-Daniel Corporation » of Connecticut, which for years had been making cinder-catchers for factory smokestacks. From this device, the « Aerotec Company », a firm created for the job, developed a small centrifugal dust precipitator which was an immediate success, cleaning air as no filter could.

In these precipitators, dust-laden air is whirled around inside a tube at high speeds. Centrifugal force throws the solid particles out to the wall of the tube, where they fall downward and are trapped for future removal.

Yellott installed a battery of these precipitators between the combustion chamber and the turbine and the problem that had baffled inventors for half a century was licked. The precipitators take out 95 percent of the fly-ash, and the remaining dust, says Yellott, you could put in your eye without noticing it. The air which his locomotive will exhaust, he states, may actually be cleaner than the air it takes in. And if experiments now under way in another laboratory at Purdue University are successful, the ash salvaged by the precipitators will be used for sanding the rails, supplanting the two tons or so of sand now carried by locomotives.

The advantages offered by the new coal-burning turbine sound like a railroad man's dream. Calculations indicate that Yellott's blue-print locomotive, soon to be built, will be three or four times as efficient as today's coal-burning steam locomotive. It will use no water — a great advantage everywhere and especially in arid sections. With no boilers to inspect and clean and few moving parts, it will be far cheaper to maintain It is so compact that a locomotive half the length of a Diesel-electric will deliver an equal amount of power. It will use any kind of coal, even the cheap lignite variety found in abundance in Texas, Montana, North Dakota, and parts of Canada.

Low fuel cost.

Coal to run it will cost about one half as much per ton mile as fuel for a Diesel, and will probably cost relatively

Thermal efficiencies of locomotive power plants	
Diesel	36 percent
Gas turbine	24 percent
Reiprocating steam engine	8 percent

Average fuel costs per million Btu (December 1945)	
Diesel oil	39.0 cents
Fuel oil	17.3 cents
Coal	13.1 cents

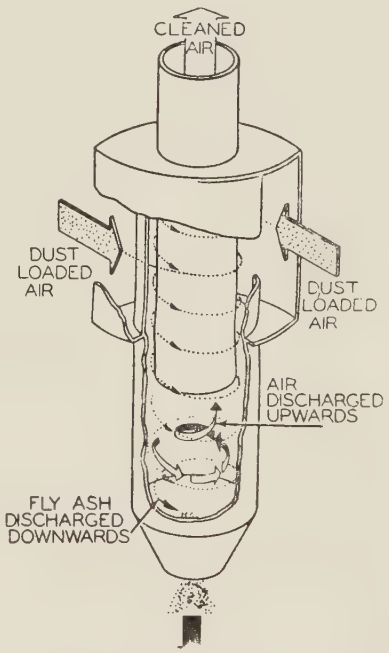
Turbine efficiency is only two thirds that of a Diesel; now low cost powdered coal, burned directly in a turbine unit, more than offsets lower efficiency.

less in the future. It is certain that Diesel oil will never be any cheaper, and Yellott has plans that may make the powdered-coal gas turbine even more economical. For example, he hopes to eliminate the electric drive which will serve as a gearshift in the first coal-burning « turbomotive » as it does in the Diesels now on the rails. Gearing the turbine directly to the wheels by means of an automobile-type gearshift would cut the fuel bill still more as well as reduce initial and maintenance costs.

Oil-burning gas turbine locomotives will be only two thirds as efficient as Diesels. The Diesel is still the most efficient internal-combustion engine in the world, delivering as high as 36 percent of the power potential of its fuel as against the gas turbine's 24 percent, the central station steam turbine's 30 percent, and the steam locomotive's 8 percent. But the gas turbine can now burn coal which costs only one-third as much per heat unit as Diesel fuel, thus more than canceling out the Diesel's efficiency advantage.

The turbine locomotive will not pound the rails because it has no reciprocating piston action. Still another virtue of the turbine which appeals to railroad men has been noted by jet-plane pilots in cold northern climates. When a gas turbine draws in cold air, its power goes up by as much as 50 percent. This is because cold air is denser, and much more of it can be driven through the compressor with the expenditure of less power. This fits neatly with the fact that it takes more power to pull a train in winter, when grease congeals and the wheels of a standing train often freeze to the rails. The exhaust from the turbine can also supply the comfort-heat requirements of the train.

Many other possibilities lie ahead. Convertible gas turbine locomotives which will burn either coal or oil are being considered. Thus a train leaving the oil-rich West Coast could switch to coal east of the Rockies. The coal-burning gas turbine should be ideal for stationary power plants in regions which have plenty of coal and a limited water supply. Suitable for loads all the way from 500 to 10 000 horsepower, it may once more make coal supreme on the seven seas. Oil-burning gas turbines are now being built for ships, and



Principle of operation of the Aerotec tube as applied to removal of fly-ash from hot air that operates the new coal-burning turbine rotor.

a shift to coal would be a big money-saver. Yellott has his eyes on harbor tugboats, which he thinks may well be marine pioneers in the new power.

« Bituminous Coal Research, Inc. », which sponsors the present work, through its Locomotive Development Committee, is taking out patents only to keep the development from being

bottled up, and will license all firms which want to build the new engine. The Committee's major interest is in promoting the use of coal.

Other uses.

Important offshoots are being explored. As a long-range project, Yellott plans to bring to fruition Diesel's old scheme of feeding his internal-combustion reciprocating engine on coal. He has in mind an attachment for the engine to pulverize the coal, turn it into gas, and inject the gas into the cylinders. Meanwhile work is progressing on a home furnace to be fed automatically with an air-driven stream of powdered coal. The « face-powder » fuel would be delivered in dust-tight containers. Combustion would be practically complete and smokeless, the remaining cinders would be removed by adapted Aerotec tubes, and houses would have exhaust pipes instead of chimneys.

Next to atomic energy possibilities yet unrealized, the gas turbine ranks as the most important power development of the 20th Century. The new engine in Baltimore, designed to conserve vanishing oil and to use abundant coal, promises to complete the power revolution which the gas turbine has started.

[625 .233]

Fluorescent lighting of railway carriages,

by M. MARCEL DURAND,

Engineer of the International Sleeping Car Company.

(Revue Générale des Chemins de fer.)

The International Sleeping Car Company introduced fluorescent lighting in a restaurant car of the Paris-Nevers service, on November 10th. 1944. It appears to us to be of interest to describe some details of this installation — the first in Europe — its practical results, and the future prospects of this method of lighting in railway carriages.

The manufacture of fluorescent lamps in France has been undertaken only since the war. Consequently many difficulties were encountered during the stages of development.

Notwithstanding unfavourable conditions, a certain number of installations were completed in buildings, enabling the remarkable qualities of this new form of lighting to be verified. It seemed to us therefore that its application to railway carriages should be studied.

It is necessary to point out that fluorescent lamps, which must not be confused with luminous tubes, make use of the properties of an electric discharge through a mercury vapour of low pressure. The visible luminosity of such a discharge is small, but there is an intense radiation of ultra-violet rays, capable of exciting fluorescent substances which are deposited in a thin layer on the interior surface of the tube. The illumination is therefore produced by the alteration of wave-lengths of ultra-violet radiations and particularly the ray of 2 537 angstrom units which activates the fluorescent powders with maximum efficiency.

The advantages of fluorescent tubes are :

a) A high degree of efficient illumination in the order of 40 lumens per

watt, against 10 lumens per watt from the usual incandescent lamp of the same power rating.

b) Low brightness, being 0.3 c.p. per cm^2 (0.3 c.p. per 0.155 sq. in.) against 200 of an incandescent filament. There is no dazzle effect and lamp shades are unnecessary.

c) Good tone of the produced light : a wide diffusion and the possibility of obtaining exactly the desired luminous spectrum. In general, the manufacturers supply the tubes in three nuances of white colours : from the « daylight » type (which does not affect colour aspects) to the « warm-white » which is richer in red rays and more pleasant.

d) A rectilineal design providing an illumination in harmony with the internal structure and modern decoration.

e) A life of 2 000 to 3 000 hours, compared with the generally accepted 1 000 hours of the tungsten filament lamp.

With these advantages it can be expected that the fluorescent tube will rapidly take the place of the incandescent lamp wherever alternating current supply is available, and as soon as production can meet the demand.

For railway carriages, the advantages did not appear to be so evident and required to be proved. The utilisation of this method of lighting presented some technical difficulties.

In the first place, the usual 24 volt direct current cannot be directly applied and it is necessary to transform it to a high voltage a.c. supply, to provide for the starting up or « striking » of the tubes. Energy losses in the transformation might cancel out the economies gained through the high efficiency of the tube. In the second place, the necessary a.c. convertor machine and the supplementary regulator apparatus might increase the weight of the whole equipment and introduce some complications.

To all this must be added the fact that, practically, no automatic generator of alternating current had ever been installed on a railway coach so that something more than a theoretical study was required, no less than a practical demonstration to verify the claims (1). The equipment recently installed by the International Sleeping Car Co. has been carried through under very difficult conditions concerning the supply of materials. Many details are susceptible of improvement, but the first results obtained from the trial equipment created so much interest that it merits a detailed description.

The restaurant car selected for this test is of the metal body type of normal design. Previously the lighting was provided from à Dick System with a 24 volt dynamo feeding the usual incandescent lamps. The lamps were placed on the ceiling over the tables and also as side brackets on the walls. For the smaller dining saloon there were on the ceiling : 6 lamps of 27 volts, 25 watts, 325 lumens, and on the brackets : 12 lamps of 27 volts, 15 watts, 172 lumens, giving a total lighting effect of 4 000 lumens, at the normal average voltage with the train in motion.

In this same dining saloon the lighting is now provided from 6 fluorescent tubes each 1 m. (3′ 3⅜″) long, disposed in the form of a rectangle against the ceiling.

These tubes are of 22.5 watts, 1 150 lumens, and operate with their auxiliary apparatus at 220 volts. The total amount of light is 6 900 lumens, there being no variation whether the train is standing or in motion, since the supply voltage is held constant by means of a device to be described later.

---

(1) Actually some a.c. equipments were installed about 10 years ago on a few restaurant and Pullman cars of the International Sleeping Car Co. comprising special regulators and other devices — not for lighting but for electrophones, wireless receivers and panatropes.

In the larger dining saloon, the foregoing figures of illuminating power must be increased in proportion to the increased number of tables, the same standard of lighting effect being maintained.

Formerly the kitchen was lighted with four 25 watt lamps giving a total of 1 300 lumens when the train was in motion. These four lamps have been replaced by two fluorescent tubes of 22.5 watts giving a total lighting value of 2 300 lumens.

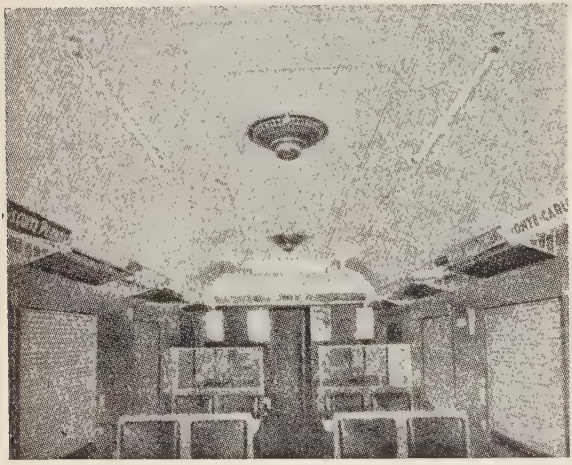


Fig. 1. — Position of the tubes in the large dining saloon.

In the adjacent corridors and at the entrance to the pantry and store rooms smaller tubes only 0.5 metre (1′ $7^{11}/_{16}$″) long have been installed giving 525 lumens with an energy comsumption of 15 watts. Each of these tubes have taken the place of an incandescent lamp of 25 watts, 325 lumens.

The selection of a tension of 220 volts — imposed for several reasons — has enabled much smaller cables to be employed than those of the 24 volt circuits. Aluminium wires have been used of the sizes 12 and 16/10. The diminution in the number of points has simplified the wiring. Nevertheless an emergency circuit at 24 volts has been retained which provides some illumination in the event of a failure in the alternator. This 24 volt circuit is also used by the cleaners when the vehicle is in the carriage sheds at night time.

In the external and internal gangways or entrances the original 24 volt lighting has been conserved to meet the Defence Regulations. The lamps had to be coated with a blue paint so it was not expedient to use high intensity tubular lamps at these points.

The fluorescent tubes are attached to the roof by means of special sockets and provide for easy uncoupling for cleaning or replacement. The starting relays (for those tubes which require them) are placed inside the socket supports. The choke coils are fitted in suitable covered positions in the ceiling in close proximity to each tube fitting.

The selected tubes were the standard models then available in the lamp industry. In the dining saloons the one metre tubes are of the pattern in general use on 220 volt supply services. Starting up is obtained by the pre-heating of the electrode filaments. The closing and opening of this circuit is automatically operated by a bimetal switch enclosed in a small neon tube. Although more rapid in starting than the foregoing system, the resonance method has been rejected because each circuit comprises several tubes and the failure of one of them to operate would have damaged the corresponding oscillating condensor. In the corridors, the half metre tubes are those usually employed on 110 volt installations. They are coupled direct to the 220 volt circuit whereby instantaneous lighting up is obtained without recourse to any special starting device. Voltage drop is obtained through an appropriate choke. This simple and practical method is being tried in view of its future adoption in

sleeping cars where is desirable that instantaneous lighting should be available.

The several circuits in the coach are controlled from a distributing panel. It comprises two rotary type main switches, one of them operating the direct current circuits (emergency, platforms, ventilator fans, bells), while the other controls the alternating current circuits. The closing of this switch starts up the rotary convertor set automatically. On the switchboard are also mounted the auxiliary switches and fuses, and an ammetre showing the dynamo output.

The original d.c. train lighting dynamo equipment is retained in use, comprising one shunt wound dynamo of 2 250 watts, a voltage regulator with

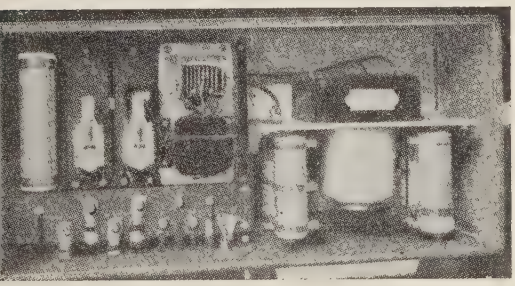


Fig. 2. — Starting and regulating apparatus in metal box.

auxiliary relays and a lead-acid battery of 12 cells of the « cuirassé » type (glass wool separation).

The alternating current is produced by an a.c. generator driven by a shunt motor. This set is of the monobloc type having one frame, and the two armatures being mounted on one common shaft. This equipment is suspended under the body of the coach with suitably sprung suspension irons.

Starting up takes place in two stages. Upon closing the main switch, a primary relay completes the circuit from the battery to the motor armature through the intermediary of a starting resistance. When the C.E.M.F. of the motor is sufficient a second relay connected to the armature terminals comes into action and short circuits the starting resistance. The speed of the combined machine is kept strictly constant by means of a regulator placed at one end of the armature shaft acting upon the motor excitation according to the variation in supply from 22 to 30 volts. As the running speed remains constant so does the frequency of the generated alternating current.

The voltage of the a.c. output is subjected to a dual regulation. The first is obtained through a compound winding in the generator field. The series coils carry a fraction of the current feeding the motor, which varies propor-

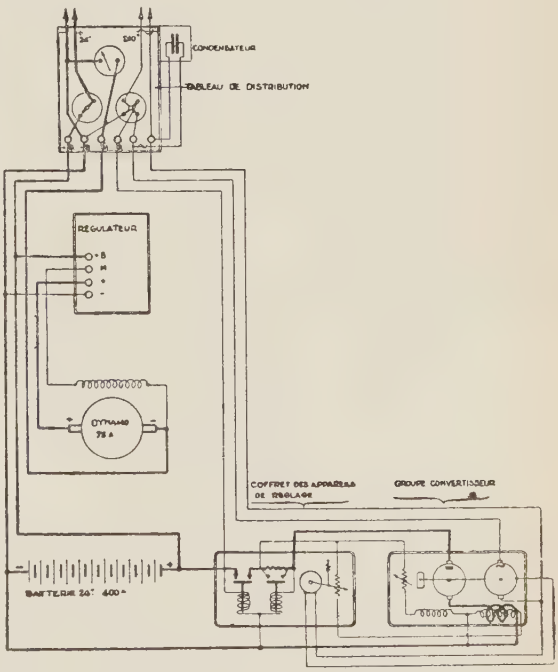


Fig. 3. — Fluorescent lighting. Schematic diagram of generator equipment.

Explanation of French terms:

Condensateur = condensor. — Tableau de distribution = switch board. — Régulateur = regulator. — Coffret des appareils de réglage = box of the regulating apparatus. — Groupe convertisseur = convertor group.

tionately to the output of the alternator. A second regulation is obtained by means of an electro-dynamic multivibrator acting on the shunt excitation of the alternator. The control circuit of this regulator (a motor-couple) is fed by a fraction of the a.c. pressure reduced through a transformer and then rectified by a copper oxide rectifier connected up on the wheatstone bridge method.

The whole of this regulating apparatus and the starting relays are housed in a small sheet metal box fixed under the coach in proximity to the group (fig. 3).

The power factor of the tubes being in the order of 0.5 a correction condenser of 40 microfarads has been placed alongside of the switch board so that on full load the cosine φ of the installation is nearly unity.

The original d.c. lighting system was not provided with voltage regulators in the lamp circuits, consequently the voltage varied with the speed of the train, and also according to the condition of the battery.

In order to compare the old system of lighting and the new, in which the voltage and emitted illumination are kept rigorously constant, certain tests have been carried out :

a) before the change over of the system, the lamp voltages with the train standing and again with the train running (an average of 27 volts);

b) after the changeover, at the normal pressure of 220 volts.

Numerous photometric tests were taken with the following results : with the incandescent lamp system, the lighting power varied from 16 to 18 lumens with a standing coach and 62 to 75 lumens when running. With fluorescent tubes, the lighting varied from 125 to 195 lumens.

The average lighting effect is therefore doubled when the train is running and six times more when standing.

The foregoing measurements were taken in the dining saloons. In the kitchen the results were even better, due to the shorter length of the tubes permitting an improved position for the distribution and diffusion of the light.

With the previous system the installed lighting power amounted to 1 045 watts (excluding minor auxiliary circuits of 80 watts which have not been changed). With the fluorescent tubes; the energy consumption is only 576 watts (including the losses in the accessory apparatus), that is about one half of the former energy requirements.

The decrease in the power consumption for lighting does not entail a reduction in the generator load because the a.c. convertor group with an efficiency of 55 % absorbs 1 040 watts $\left(\frac{576}{0.55}\right)$ from the d.c. machine.

Notwithstanding the considerable loss in conversion from d.c. to a.c. *the use of fluorescent tubes has brought about a substantial improvement in the lighting of the coach without having to increase the power of the d.c. generating set.*

It will be of interest to give some information about the weight of the apparatus in view of the present demand for weight reduction in railway rolling stock.

Before the transformation the weight of the complete electric lighting installation was 1 150 kgr. (2 540 lb.). This figure includes the dynamo 190 kgr. (420 lb.), the accumulators 550 kgr. (1 210 lb.), the battery containers 240 kgr. (530 lb.), the regulating apparatus, the switch panel, cabling, fittings and lamps.

The new system necessitated the addition of supplementary material weighing 160 kgr. (354 lb.). This weight includes the converter group 80 kgr. (176 lb.) and its suspension gear, relay apparatus, etc., in a small metal box, condenser and wiring in conduit.

On the other hand, the smaller diameter of the wiring has introduced a saving of 25 kgr. (55 lb.). The net increase in the weight therefore amounts to 135 kgr. (298 lb.), being about 0.2 % of the total weight of the vehicle (54.1 tonnes or 53.2 Engl. tons), so that the increase is insignificant.

In reality there is another aspect to this question, namely a statement of the extra weight that would be involved with the previous system if called upon to produce the present lighting effect without the use of fluorescent tubes. The installation of more incandescent lamps and of greater power would involve the provision of a larger dynamo. Furthermore, to obtain the same uniform lighting when stationary or running a voltage regulator would have to be included. The exact figures can be given as such an installation has been carried out on other restaurant cars of similar class and size. The weight is 2 160 kgr. (4 760 lb.), comprising the dynamo 240 kgr. (530 lb.), the accumulators 1 100 kgr. (2 420 lb.), the battery containers 480 kgr. (1 060 lb.), regulating apparatus, switch panel, wiring, fittings and lamps. It is seen therefore that to arrive at a lighting power of the same order using incandescent lamps the increase in weight would have to be 2 160 — 1 150 = 1 010 kgr. (about 1 ton). As the actual increase has been only 135 kgr. (297 lb.) it could be said that *fluorescent lighting has saved 875 kgr. (1 930 lb.) in the weight of the vehicle.* This is an interesting saving.

Under present day conditions the question of costs is not readily answered, but it can be affirmed that this installation has been less costly than if it had been carried out with incandescent lamps. The reason for this is that the replacement of the dynamo by one of double the power has been avoided. Further items not required are : a lamp voltage regulator, the construction and fitting of an additional battery container, and, above all, the purchase of a new battery.

The light given out by the installed tubes is of a white colour slightly red or rose (warm-white), clear but warm and soft, with a diffusion covering all parts of the saloons, appearing to improve the atmosphere. The feeble effect of brilliance at the source due to the extended surface of the lighting units and their position against the ceiling suppresses glare or dazzle, thus allowing for increased illumination without fatigue to the eyes.

During the trials, travellers and staff have expressed satisfaction with the new system of lighting. In practice the tubes have given no trouble, neither electrically or mechanically. Although of the type intended for installation in buildings, they have resisted the violent shocks and vibrations of railway rolling stock, notably when a coupling broke soon after they were installed. It has also been verified that the convertor group makes no noise, due to its low speed, its perfect suspension and the use of shock absorbing pads.

It can be deduced from the foregoing account that the use of fluorescent tubes opens up the possibility of increasing considerably the lighting of a coach already fitted with an electric system without having to replace the dynamo. Such a scheme provides substantial improvements to a coach without adding to its weight and not only increases the lighting effect but also modernises the decorations.

In new coaches, fluorescent tubes will enable a more equal distribution of the lighting and permit the use of lower power units; consequently reduction in weight. This point will apply particularly in the construction of light rolling stock. The shape or design of the tubes coupled with their low dazzle effect gives a wide choice for their positioning with the elimination of shadows.

They will be particularly appreciated in compartments having sleeping berths one above the other, in travelling postal vans, etc...

The application of alternating current at standard voltage for the lighting of railway carriages introduces certain advantages. In terminal stations where standing time may be prolonged and in the carriage sheds the lighting could be plugged in to the local a.c. supply circuit. This important benefit cannot be applied to coaches with the usual 24 volt lighting system. It also increases the life of the battery. It should even be possible to arrange the rotary convertors to be reversible so that a battery on a stationary coach could be given a charge. This provision would also facilitate the employment of special service coaches such as : exhibition trains, sleeping-car-hotels, headquarters trains, ambulance trains, postal vans, etc. No modification would be required concerning the lighting equipment.

This new system of lighting that we have described is not a prototype and it will be possible to improve upon many details. Nevertheless, this experiment has shown the possibilities of lighting railway carriages by means of fluorescent tubes.

[621 .132 .8 (.73) & 621 .438 (.73)

Locomotives for today and tomorrow,(*)

by CHARLES KERR, Jr.,

Consulting Transportation Engineer.
Westinghouse Electric Corporation.

(*Railway Age.*)

Today the railroads are generally operated by three classes of motive power — reciprocating steam, Diesel-electric and electric. But new types are rapidly coming into use. In 1944, the geared steam turbine made its appearance and promises to open new fields for steam power. Soon the first coal-burning steam-turbine-electric will enter service. And, in the not too distant future, the gas-turbine locomotive is certain to appear. With the diversity of operating conditions encountered by the American railroads, there are places where each of these types can be put to good use, and none should be « sold short ».

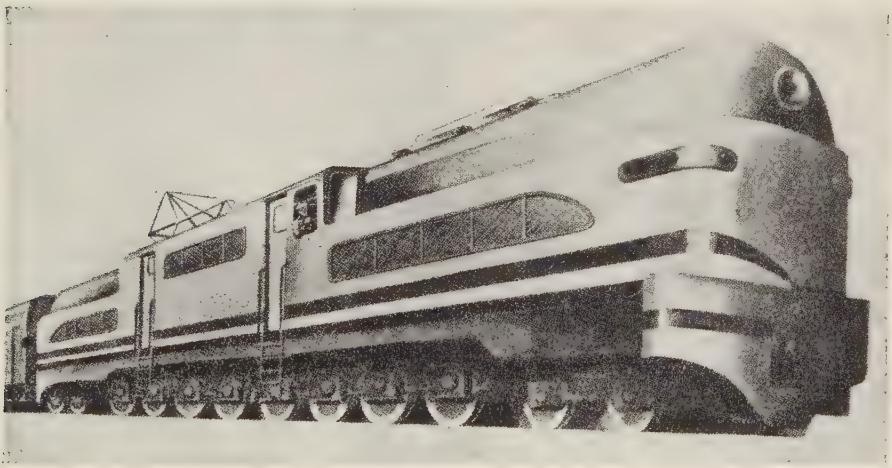
Electrification.

Unfortunately, because of a rather high first cost, electrification has been confined in its application to lines of heavy traffic density, or to the solution of operating problems which, by other means, could not be overcome. However, in spite of this handicap, certain trends are appearing which are likely to produce an extended use.

First. — The railroads must continually improve their service to prevent their competitors obtaining a large share of the nation's traffic. To meet this competition and keep the traffic on the

(*) This article is an abstract of a paper presented before the New York Railroad Club in New York, N. Y., March 21, 1946.

An electric locomotive with a continuous rating of 7 500 hp.



A 10 000 hp. (continuous rating) electric locomotive with a 2 - D + D - 2 wheel arrangement.

rails where it belongs, passenger trains will eventually operate at 100 m. p. h. or more, and freight trains at 70 m. p. h. or more. To maintain such speeds continuously, locomotive capacities will exceed those generally in use today. Operation of heavy traffic under these conditions enhances the economies to be derived from electrification and broadens its scope of economical application.

Second. — The direct operating expenses of an electrified railroad are the absolute minimum. With inflation facing us, this feature of electrified operation will become increasingly attractive.

Third. — With the continued increase in efficiency of centralized power generation, the trend of electric-power costs has been downward while all other fuels are steadily increasing in price. Electricity is produced by burning coal or by water power, our most assured long-range sources of energy.

If the first cost is to be reduced, there must be greater standardization. In ad-

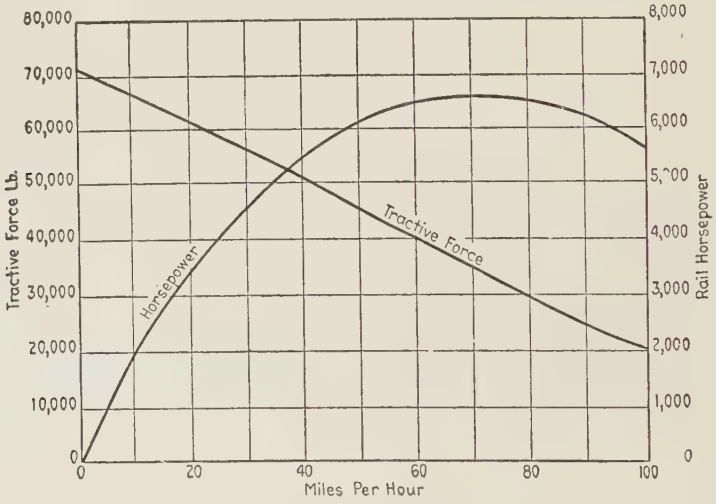
dition, it should be made easier for a railroad to electrify. Any railroad should be able to purchase an electrification, completely engineered and installed, for a definite price, accompanied by a long-term power contract and a simple plan of financing. Electrification should be just as easy to buy as any other type of motive power.

Typical example of tomorrow.

To show what may be accomplished by electrification, I would like to present two locomotives which are typical of the electric locomotive of tomorrow.

The second design is similar to the first one shown, except it has eight driving axles. Without exceeding generally acceptable dimensions and weights, 10 000 continuous horsepower can be developed, or 17 000 maximum horsepower.

Both locomotives can meet practically any desired combination of speed and axle loading. They can be built to operate on either d.c. or a.c. systems and production could be started on short notice. They have sufficient power to handle heavy passenger trains, 15 to 20 cars, at speeds of 100 to 125 m. p. h.,



Performance characteristics of the Pennsylvania class S-2 geared turbine locomotive.

The first of these locomotives has the conventional 4-6-6-4 wheel arrangement. This cab and general wheel arrangement make the best operating unit known to the locomotive art. Despite its familiar outward appearance, it nevertheless differs inwardly from its predecessors. With six pairs of drivers, it is physically no larger than present designs and only slightly heavier. But it carries 50 per cent more capacity, or 7 500 continuous horsepower and 13 000 maximum horsepower.

over long stretches of varying profiles, or to handle 100- to 125-car freight trains at 70 to 75 m. p h. under similar conditions. They will meet any foreseeable future requirement.

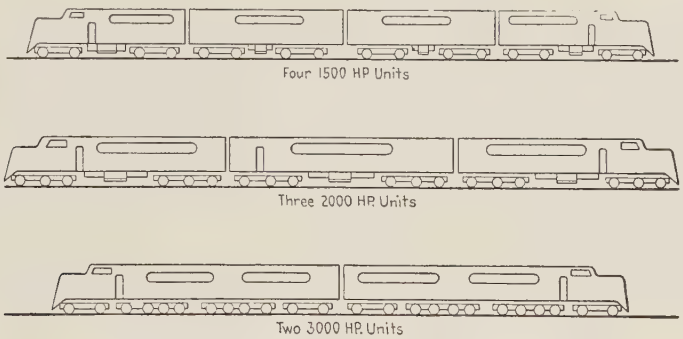
The Diesel electric.

The Diesel-electric has characteristics which make it especially well suited to switching, transfer and branch-line service, where, as a general rule, units of 2 000 hp. or less are required. Road service demands big locomotives. The

largest Diesel road locomotive develops 6 000 engine horsepower. When the losses between engine and rail are deducted, the net horsepower available is approximately 5 000. As now constructed, these locomotives comprise two, three, or four units totaling approximately 200 ft. in length, and weigh between 185 and 230 lb. per rail horsepower.

Of the various single units now manufactured, the largest delivers about 2 500 hp. at the rail, or 3 000 engine horsepower. By comparison, in the same overall length, a 10 000-hp. electric locomotive can be built — just four times the effective continuous capacity of the Diesel. Furthermore, this electric has overload capacity and the Diesel does not. Steam power is approaching 8 000 hp. or almost three times that of the Diesel. And there will apparently be demands for still larger power.

To appraise completely the Diesel road locomotive, it is interesting to examine the requirements of present designs when handling large trains at various speeds. At 80 m. p. h., two conventional cabs are sufficient to handle modern 17-car trains weighing 1 150 tons and at 100 m. p. h., three cabs are ample. At these speeds, the motive power is within present standard practices. However, should passenger speeds exceed 100 m. p. h., the Diesel locomotive, as it exists today, might rapidly become a monstrosity. For a 125 m. p .h., the locomotive is 370 ft. long and weighs 80 per cent of the train it hauls. About one-half of the power developed by the locomotive is wasted in pulling itself. These power requirements provide no margin for adverse grades, or for rapid acceleration to these speeds. The requirements have not been exaggerated.



Diesel locomotives for high-speed passenger service

Purchasers demanding speed.

In high-speed freight service, to operate a 5 000-ton train at 70 m. p. h. requires almost three times as much locomotive capicity as that required at 40 m. p. h. The locomotive becomes a fair sized train in itself. Many requests which we are now receiving for new locomotives demand provision for future operation at such speeds, indicating that railroad managements are anticipating them.

The limitations of the Diesel locomotive are often accredited to the electric transmission, and by the same token, it is claimed that everything would be all right if it could be avoided. Actually, the Diesel engine has very poor charac-

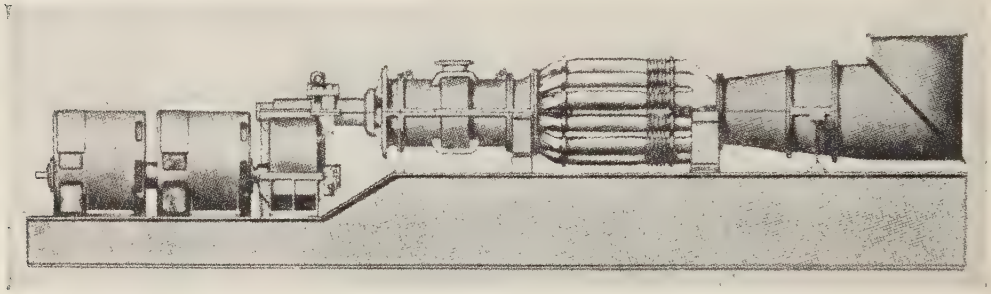
teristics for traction purposes. Electric transmission has provided a very flexible means for delivering power to the rail, and has permitted the prime mover to be designed with the greatest freedom from many burdensome restrictions.

The long-range status of the Diesel locomotive would be bettered if greater capacity could be built into a single unit. Physically, the largest single-unit locomotive which can operate within the clearance restrictions of most roads is about 92 ft. long, employing twelve carrying axles, any number of which can be made into driving axles.

With motors that are now in large-scale production, only eight driving axles are needed to give ample starting and continuous tractive force for most passenger service. The largest engine capacity yet placed in this size cab is 3 000 hp. Electrical equipment now available can utilize 6 000 hp., but the Diesel engines, to produce 6 000 hp. in this space, are yet to be produced.

With this same running gear, and the same motors, a freight locomotive could be built with all 12 axles motorized, providing 180 000 lb. starting tractive force and 125 000 lb. continuous tractive force. Actually, these 12 motors could absorb 9 000 Diesel-engine horsepower if the Diesel engines were available to deliver this amount of power.

We believe that eventually the most serious limitation of the present Diesel locomotive will prove to be its relatively poor weight and space efficiency. We want to see these improved, for then the future of the Diesel will be even brighter, with its field of application ranging, without undue restrictions, from the smaller sizes suitable to switching service to the largest main-line requirements of the future.



A 2 000-hp. gas turbine with geared drive and electric generators. — The unit is 26 ft. 3 in. long, $3^1/_2$ ft. wide and 6 ft. high.

Steam locomotives.

Today, steam is encountering the toughest competition of its long and useful existence, but you can rest assured the old « iron horse » is far from dead. The steam locomotive is rapidly becoming three locomotives — reciprocating, geared-turbine and turbine electric. The modern reciprocating locomotive is the product of 125 years of constant development. New developments are usually confined to a perfection of details which, in the aggregate, result in extensive progress.

The so-called « duplex » locomotive is probably the answer to reciprocating drives for very large locomotives. Where increased power must be produced, the trend in all reciprocating-engine practice, including internal-combustion engines, is towards higher speeds of re-

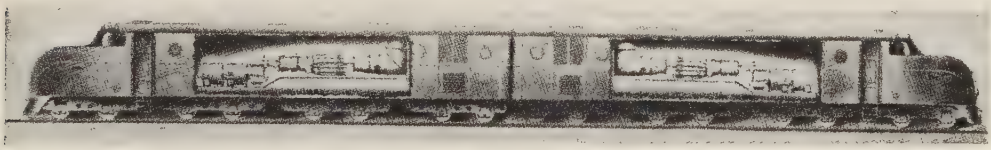
ciprocating parts, lighter-weight parts and increased number of cylinders.

In late 1944, the Pennsylvania took delivery of the first American geared-turbine locomotive, known as its Class S-2. This development represents one of the most important changes in the power principle of the steam locomotive in over 100 years, and gives promise of a great future in the field of train transportation. Approximately 50 000 miles of revenue service have been accumulated. Naturally, some troubles have been experienced, but they have been less serious than any of us had anticipated.

Geared turbine.

The propulsion equipment on the Pennsylvania turbine locomotive was designed to follow proven marine and rail practices to the greatest possible extent. The Pennsylvania locomotive was built with gearing selected for maximum operating speeds of 100 m. p. h. with a 10 per cent margin for overspeeding. With this selection of gearing, it is a high-speed passenger or freight locomotive. Where the predominating operating speeds are higher or lower, a suitable selection of gearing can be made.

One limitation of the steam locomotive has been the necessity for using side rods and large-diameter driving wheels. These have limited the selection of wheel arrangement, and most important of all, the large wheels have reduced the space available for the boiler which, after all, is the ultimate limit of capacity. Work is progressing on a geared-turbine drive to remove these obstacles to the steam locomotive. This drive will permit 48-in. drivers to be used, irrespective of the maximum speed desired, and will substitute a longitudinal shaft and bevel gearing to take the place of the side rods. A reverse gear may be incorporated in the high-speed gear reduction to eliminate the reverse turbine. Furthermore, with the proposed type of reverse gear, a different gear ratio can be provided, if desired, in the two directions of operation.



A proposed type of two-unit locomotive which might use four 2 000 - hp. gas turbine for freight service.

The weights of the actual turbine and drive are quite interesting. The main turbine, producing 6 900 shaft horsepower, weighs 5 000 lb., or less than $^{3}/_{4}$ lb. per horsepower. The entire propulsion apparatus, including auxiliaries and control, runs less than 6 lb. per horsepower. To our knowledge, these are the lowest weights ever attained in propulsion equipment for traction purposes.

One of our big surprises when the turbine locomotive was first announced was the discovery that many people did not appreciate that a turbine could produce sufficient starting tractive force for train operation. Actually, the characteristic performance of a geared turbine is well adapted to traction purposes.

A geared-turbine drive of this character would permit radically new types of steam power to be built. For example, there is a design developed by the Pennsylvania Railroad, employing the geared-turbine drive which we have described, in which the truck-type of running gear becomes available in steam

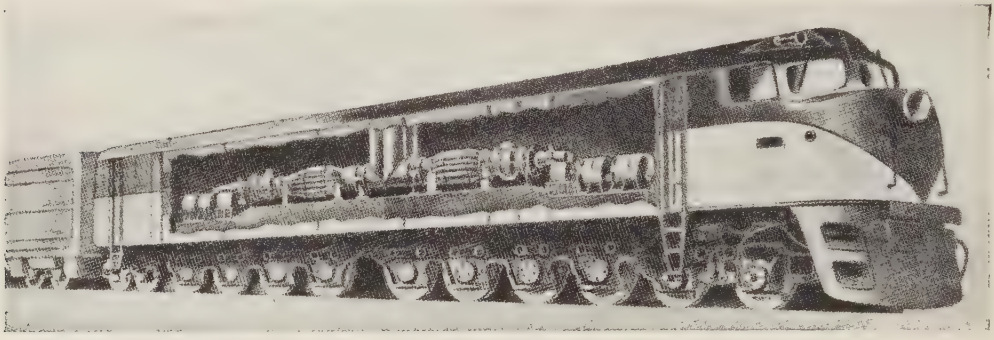
practice, introducing a type of locomotive which has proven so eminently satisfactory in electric and Diesel-electric practice. Thus, excellent tracking characteristics are assured. In addition, restrictions are removed to the firebox, grate and ash pan. This locomotive, developing 9 000 hp., would be driven by two turbines, one on each truck.

Another application might be to the conventional 4-8-4 type, in which the wheels are small and the rigid wheel base is shortened. The turbine is located under the smoke box, simplifying the steam piping. The short rigid wheel base provides space for a larger grate and fire box, increasing the efficiency of burning fuel. The small wheels afford space for a larger-diameter boiler, reducing the draft loss. These factors indicate a locomotive with better operating charecteristics and better overall efficiency.

A third application of this drive is an attempt to provide the ideal universal freight and passenger locomotive. With small wheels, six driving axles can be introduced into the same overall wheel base now taken by fewer axles. The tender has also been redesigned to be either pushed or pulled, employing an arrangement of wheels to permit this kind of operation. The reverse gear provides a different gear ratio in the two directions of motion. Running with the locomotive forward, the locomotive would be a 120 m. p. h. passenger unit; with the tender forward, a 70 m. p. h. freight unit, providing improved characteristics in the speed range common to freight service With six driving axles, sufficient boiler capacity can be carried to develop 8 000 to 9 000 hp. without excessive wheel loads.

Gear shift a possibility.

Before leaving the geared-turbine drive, I would like to introduce one other future possibility — a gear shift.



Gas turbines might be used in the manner shown to produce an 8 000-hp. passenger locomotive.

Designs of a gear shift have been made, and the equipment for a large locomotive is about the size of a bushel basket. The gear shift makes possible a locomotive with a maximum tractive force of 140 000 lb., capable of developing over 7 500 hp. at all speeds from 20 to 100 m. p. h., and with essentially a constant steam rate over this whole speed range. A single locomotive becomes suitable for any type of rail service, drag freight, high-speed freight, or passenger.

The exact line of demarcation where electrical or mechanical drive for a turbine locomotive becomes the preferred transmission has not been fully determined. Electric transmissions have a

background of millions of miles of service, and new installations and new materials are continually producing equipments with better space and weight characteristics. They also provide certain flexibility in the overall arrangement of the locomotive that a mechanical drive cannot obtain, for electric transmission permits the prime mover to be completely disassociated from the driving wheels.

In a few months, the first coal burning, turbine-electric locomotives will enter service on the Chesapeake & Ohio, introducing another new type of steam motive power. While these locomotives will be equipped with conventional boilers, they will be quite novel in many respects. A cab-mounted 6 000-hp., 6 000-r. p. m. turbine will drive two direct-current generators through single-reduction gearing. Traction power will be derived from eight axle-hung motors. The locomotive speed will be controlled by a variation of turbine speed and generator excitation, the combination which produces the best overall efficiency.

These locomotives are being built for passenger service between Washington and Cincinnati, a territory where long severe grades are encountered in some portions, and where fast speeds are demanded in others. This class of operation is ideal for electric transmission.

The application of electric transmissions to a turbine locomotive involve certain considerations that are different from those in Diesel practice. The turbine operates at 6 to 20 times Diesel-engine speeds, has high standstill torque, will not stall if overloaded, and within reasonable limits, its horsepower is constant over a wide speed range. With these characteristics, alternating-current types of electrical transmission offer possibilities worth consideration; and this the a.c. systems are receiving. The first turbine-electric locomotives will use the d.c. drive, as it is a proven device. Further development work may make the a.c. types competitive in weight, cost and performance.

The steam locomotive needs a better boiler. The best modern steam locomotives with fire-tube boilers operate at approximately 300 lb. pressure, 750 deg. F. total steam temperature and 15 lb. exhaust pressure at full load. When operated at capacity, boiler efficiencies are about 50 per cent. Central station and marine apparatus operate under considerably more favorable steam conditions. Were the steam locomotive to operate under equally favorable steam conditions, it would be a motive power unit with low fuel expense.

The advent of the turbine drive will accelerate the development of better boilers, for it provides a means fully to utilize high pressures, high temperatures and low exhaust pressures. The steam conditions for the ideal non-condensing 6 000-hp. turbine locomotive are 600 to 800 lb. pressure, 900 to 925 deg. F. total steam temperature and 0 to 5 lb. exhaust pressure. To produce such low exhaust pressures may require auxiliary means for drafting the boiler.

Compared with the best modern practice, the steam consumption per horsepower hour would be reduced about 30 per cent. The fuel consumption would be reduced about 27 per cent, assuming the same boiler efficiency. Better steam conditions pay handsome dividends.

The burning of pulverized coal has many advantages and considerable work is under way to find means of using it in locomotive boilers. This is not, however, a simple problem. But sooner or later, it will be solved, for the burning of pulverized coal, both in a boiler and eventually in the gas turbine, is of such importance that the time and money necessary for a solution to the problem will be forthcoming to perfect a method.

While steam power is meeting the most severe competition that it has ever

known, the steam locomotive enjoys five attributes that will continue to be a thorn in the side of its competitors :

1) Low first cost. With production in equal volume, this advantage will also be enjoyed by the turbine locomotive.

2) Modern steam power, with modern maintenance methods, is making enviable availability records with exceedingly low repair costs.

3) As a means of packing power into a single locomotive unit, steam power, reciprocating or turbine, leads the parade except for electrification.

4) The steam locomotive, reciprocating or turbine, can burn either coal or oil as economic conditions dictate.

5) Better steam locomotives than we have ever known before are on their way.

The gas-turbine locomotive.

The gas turbine operates on hot air, and if all the « hot air » expended in the public press about the gas turbine could be collected, the railroads would have a cost-free fuel for all time. The gas turbine has great possibilities, but it is not necessarily a cure-all.

The fundamental theory of the gas turbine was well developed in the late 1800's. You may well ask, « Why has it not been used before ? » The answer is a simple one — Materials have not been available to withstand the required temperatures. At 800 deg. F., the gas turbine will just turn itself over. Useful work is performed only to the degree that temperatures above 800 deg. F. are employed.

There is a 2 000-hp. gas-turbine generator unit, now on test, suitable for locomotive use. The entire unit is 26 ft. 3 in. long, $3^1/_2$ ft. wide and 6 ft. high. Two units might be placed side by side in a locomotive with a center aisle, permitting 4 000 hp. of prime-mover capacity in approximately 26 ft. of cab length. This unit is designed to burn Bunker C oil. It consists of a compressor, combustor, turbine, gear unit and generators. Its overall weight is 39 000 lb. To my knowledge, this is the first American gas turbine designed and built with dimensions suitable for application to locomotives of large capacity. It is now on the test floor, getting the « bugs » worked out of it.

In the gas turbine, the products of combustion are used directly in the turbine, which operates at temperatures above 1 300 deg. F. Complete fuel combustion must be obtained in the burners, for a carryover of liquid or solid matter will erode the blades at these high temperatures. Aviation fuels cannot be used on locomotives, either from the cost or safety viewpoint. The first railroad gas turbines are likely to burn some grade of fuel oil such as Bunker C.

The second big problem is blading material to withstand the high temperatures. Material is affected both by temperature and life, for at these high temperatures the material has a tendency to « creep ». If the gas-turbine locomotive is to be successful, the life of the blading must be measured in years, not in hours.

The gas turbine, when used to drive its own compressor, has no starting torque. It must be started by auxiliary means like the Diesel. This characteristic compels the use of electric transmission, or two turbines, one for traction. The first gas-turbine locomotives will unquestionably use the d.c. system of transmission because it is a proven device and plenty of headaches exist without looking for additional ones. Eventually some form of a.c. drive may prove practical with the gas turbine, especially the rectifier conversion system.

Steam turbines have been perfected to the point where they operate for many years without repairs. Often they run for years without being shut down. Eventually, the gas turbine should ap-

proach this same service life, producing a locomotive prime mover with excellent availability and low maintenance expense.

Given a 2 000-hp. gas turbine, it is possible to design a gas-turbine locomotive for high speed, heavy duty passenger service. In a single cab, weighing 325 tons, and employing a 4-8-8-4 wheel arrangement, four 2 000-hp. gas-turbine-generator sets can be installed. These sets, placed side by side, consume less than 60 per cent of the total cab length, leaving over 40 per cent for other necessary apparatus. Eight of the driving axles would be equipped with motors providing 100 000 lb. starting tractive force when the motors are geared for a maximum speed of 120 m. p. h. The weight per horsepower developed would be considerably less than that of present self-propelled locomotives.

An 8 000-hp. gas-turbine locomotive for heavy-duty freight service, with 16 driving axles, could be built in two units. It would weigh approximately 450 tons, with all weight on the driving axles. The starting tractive force would be 225 000 lb. and the continuous tractive force 160 000 lb. at 15 m. p. h., or 100 000 lb. at 24 m. p. h. The locomotive maximum speed would be 70 miles per hour.

When coal can be used as a fuel, the gas turbine will be a serious competitor to all other types of power. The burning of coal satisfactorily in a gas turbine is no easy problem, and I hesitate to predict when it will be solved. Many people and many organizations are working hard to surmount the obstacles that must be overcome, and it may be with us sooner than some expect.

Nature of development work.

Development work in burning coal is following along two major lines :

1) To pulverize the coal to such fineness that complete combustion can be secured in the burners with no damaging solid material carried over into the turbine blade path. This system may require, for its successful use, preparing coal in stationary plants prior to placing it on the locomotive.

2) To pulverize the coal to accepted central station practice and then separate any remaining solid matter after burning, by means of centrifugal cleaners, before the products of combustion enter the turbine.

So that you will not be misled, I would like to add one word of caution. The gas-turbine locomotive is not going to be cheap. The prime mover is constructed from about the highest-price materials known augmented by precision manufacture of all parts. It will definitely be more expensive than steam power, and probably in the order of Diesel power.

There is now, and in the future, a definite place on the American railroads for all types of motive power. We, of the Westinghouse Company, so strongly believe this to be true that we are lending our efforts without discrimination, and to the limit of our facilities, to the perfection of all types — electric, gas-turbine, steam and Diesel.

[625 .142 .2 (.73) & 691 (.73)]

Seasoning ties in hours instead of months.

(Railway Engineering and Maintenance.)

Left. — T-C vapor dried, creosoted red oak crossties after two years of service in track on the Asheville division of the « Southern ».

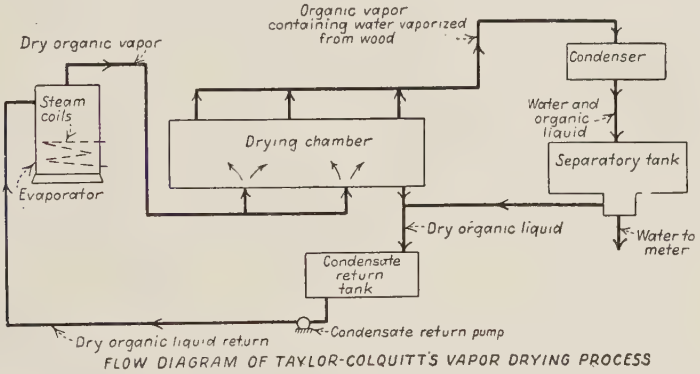
Below. — Air seasoned, creosoted red oak crossties, treated and installed at approximately the same time as vapor dried stock, after two years of service in track on the same division. Both photographs taken October 8, 1945.

A new method for seasoning crossties, switch ties, piles, poles, timber and lumber has been developed by the Taylor-Colquitt Company, Spartanburg, S. C., which not only allows an astonishing reduction to be made in time required for the seasoning operation, but which can be controlled to reduce seasoning checks and splits until they become all but negligible. That this process, which is known as the Taylor-Colquitt vapor-drying process, will also prevent the occurrence of splits and checks in subsequent service, is said to have been demonstrated by periodic observations of vapor dried crossties in test track during the last two years.

Development.

The new process, which is the product of more than six years' intensive research, was developed, first, in the laboratory, then in one of the most modern pilot plants for wood preservation in the country and, finally, in a full-

scale, completely-equipped, commercial treating plant. It opens up the promise of revolutionizing tie production, because it makes possible a shortening of the time from the stump, through the treating plant and into the track, to a matter of days instead of months, as is required under present methods of seasoning. It is claimed that the new process will remove as much moisture overnight from green red oak crossties as it is possible to evaporate from the same ties through 15 months of ordinary seasoning.

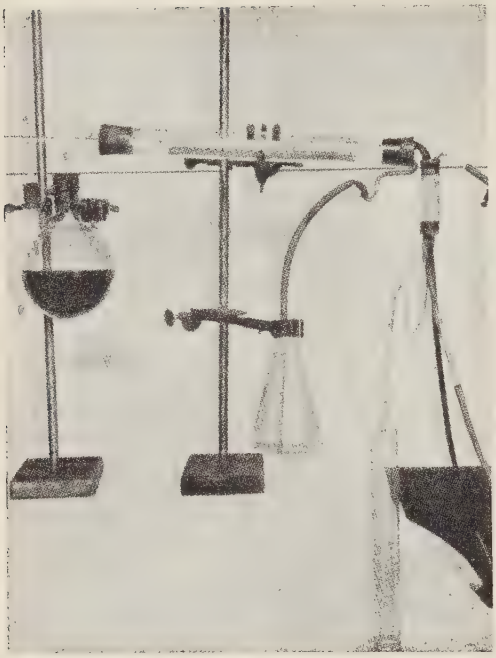


Flow diagram of the process showing also the various elements involved and the nature of the functions performed.

Four thousand gallons, more than 16 tons, of water have been removed from individual charges of 800 red oak crossties during 14 hours of vapor seasoning in Taylor-Colquitt's newly-equipped commercial plant at Spartanburg, S. C. The average moisture content of the ties was reduced by approximately 30 per cent during the process. Because of their freedom from checks and splits, the vapor dried ties stand out in sharp contrast to 15-month air-seasoned stock of the same species from the same general production territory. Gum and other quick-decaying species may now be treated while the wood is in its prime, without the feeling of uncertainty that frequently is interjected despite the most careful measures that may be adopted to avoid infection and decay occurring in the wood during air seasoning.

Taylor-Colquitt undertook preliminary experiments with vapor drying in its Spartanburg laboratory prior to 1940. As this work progressed it brought about the development of a small experimental unit equipped with a 16-in. by 72-in. cylindrical drying chamber that, in turn, led to the building of a full-scale pilot plant in 1942. Completely equipped, the pilot plant includes a pressure cylinder 26 ft. by 3 ft., which is used alternately as a drying and treating chamber for processing cross and switch ties, poles, piles, timber and lumber. With its electrically-heated evaporating unit, condenser, separator, complete electrical control, and measuring and weighing devices for vapor drying, as well as its complete equipment for Rueping treatment, this is one of the most elaborate experimental wood preservation plants in the country.

Basically, the application of the vapor drying process consists of exposing green or partially seasoned wood products within a closed chamber to high-temperature organic vapor which heats the wood and rapidly vaporizes the wa-



LABORATORY UNIT.

The simple laboratory drying unit shown above clearly illustrates basic principles involved. After the organic drying agent is heated to its boiling point in the evaporator (left), its vapor is led to a horizontal cylinder or drying chamber where it gives up its latent heat to distill water from the green wood. Any excess drying agent flows to the condensate flask (center). Vapor from the drying chamber passes to a condenser (lower right) where water is separated from the organic drying agent by gravity.

ter that it contains. The drying chamber is provided with means for removing the moisture continuously in the presence of a saturated atmosphere of an inert organic gas that is devoid of moisture and oxidizing influences. Hence, there is no opportunity for charring or hydrolisis to occur at the high temperature promoted by rapid drying, which proceeds without any detrimental effect to the wood. The process employs two principles of heat transfer : (1) a relatively high temperature range, heretofore limited to drying thin veneer where brief exposure precluded deterioration of the wood, and (2) the exposure of green wood to condensing vapors that accelerate drying by liberating large quantities of latent heat without injury to the wood as condensation takes place.

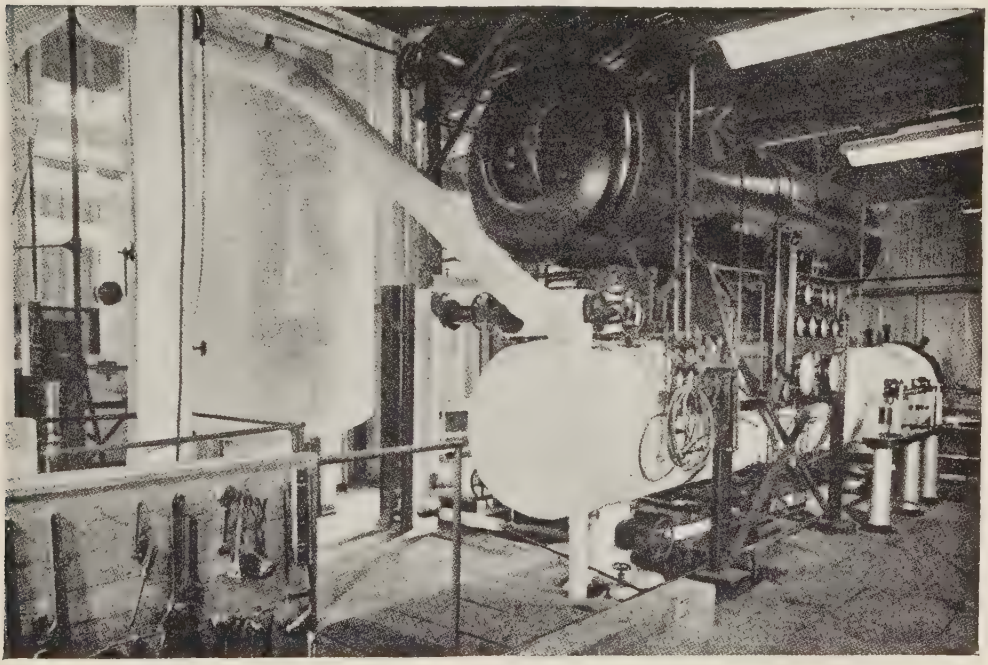
When wood is heated in steam or air or in a mixture thereof, to a range above the boiling point of water, but below the point of thermal decomposition of the wood (212 deg. F., to about 400 deg. F.), the chief causes of its deterioration are hydrolysis from the action of the steam and oxidation in the presence of air. The new process eliminnates these factors because the drying takes place in an inert atmosphere of organic compounds that serve to transmit heat to the wood being seasoned.

The accompanying flow diagram illustrates the general relative arrangement of the equipment and the operation of the process. The drying agent is heated to its boiling point by any suitable means, such as a steam coil used in Taylor-Colquitt's commercial plant, and the vapor is introduced to the lower part of the drying chamber at several different points to assure even distribution. When first it comes in contact with the wood, the vapor condenses upon the cold surfaces and gives up its latent heat of vaporization to distill the water in the wood. Any excess organic liquid that is not absorbed by the wood flows to the condensate-return tank, from which it is pumped back to the vaporizer to begin the cycle again.

As heating continues, the temperature in the heating chamber rises rapidly until it approximates that of the vapor in the evaporator. As the surface temperature of the wood increases, the line of organic vapor condensation retreats beneath the wood's surface and the flow of organic condensate from the cylinder decreases. When the temperature of

the drying chamber and the wood approaches the boiling point of the organic liquid, an excess of the organic vapor collects within the drying chamber and is forced by incoming vapor from the evaporator into the discharge manifold and thence into the condenser. This vapor carries with it the water that has been distilled from the wood, and the mixed condensate is led into a separatory tank where gravity induces separation of the two liquids. The organic liquid is conducted to a condensate return tank, from which, after joining the condensate from the cylinder, it is pumped back to the evaporator to be revaporized.

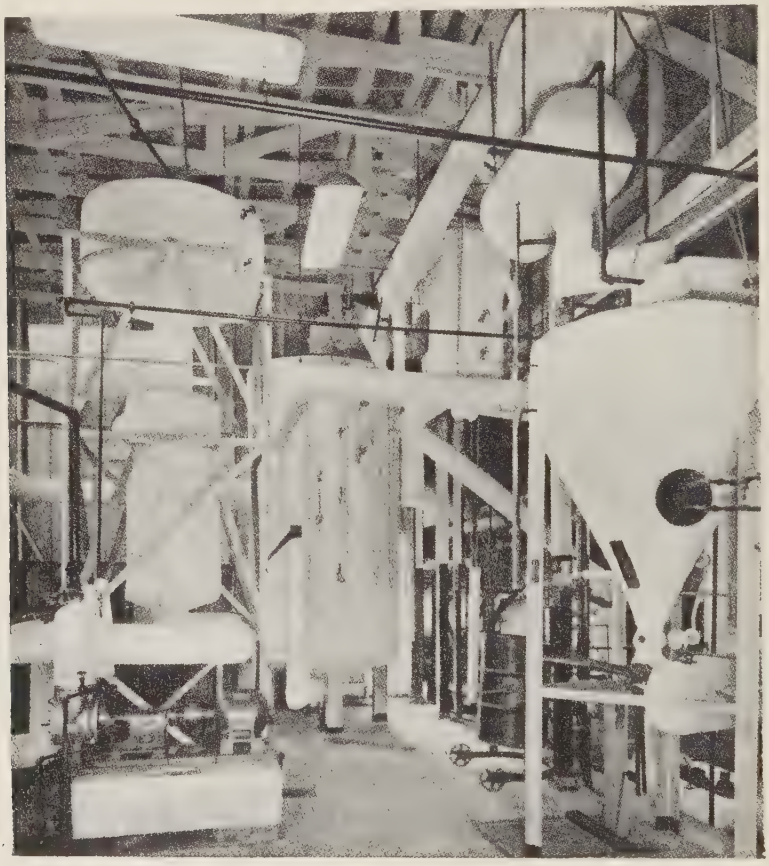
The separated water is passed through a meter, which is read periodically to determine the progress of drying, and the process is continued until the moisture content of the wood has been reduced to the desired minimum. Because at the end of the drying period the wood contains a large quantity of the liquid drying agent which has condensed during the process, and because both are at a temperature high enough to permit vaporization of the organic liquid upon application of a vacuum, the inflow of vapor is stopped by closing a valve and a vacuum is drawn on the drying chamber and its contents. The organic liquid thus removed is recovered and the dry wood, now virtually free from the drying medium, is ready for preservative treatment or for removal from the drying chamber.



View of interior of Taylor-Colquitt's pilot plant. In the photograph the large white vertical cylinder in the back-ground at the left is the evaporator. The 3-ft. by 26-ft. drying and treating cylinder is at the lower right with the Rueping cylinder overhead.

Choice of drying agents.

The circulation of the organic vapor through the drying chamber usually is conducted at atmospheric pressure and the desired operating temperature is obtained by selecting an organic compound whose boiling point at atmospheric pressure is equivalent to the temperature desired. For example, to maintain a temperature of 280 deg. F. at atmospheric pressure in the drying chamber, the chemical compound xylene, whose boiling point at atmospheric pressure is 280 deg. F., might be used; if a temperature of 300 deg. F. were required, a coal-tar distillate known as high 1-1 flash naphta would be satisfactory. If a temperature of 240 deg. F. is required and xylene is the only available drying agent, the conditioning may be accomplished by conducting the vaporization and circulation of xylene through the system under a vacuum of about 14 in. of mercury, which is the



View of interior of Taylor-Colquitt's pilot plant. In the view the evaporator is the large cylinder in the central background, the condenser is near the roof trusses in the right foreground, with the funnel-shaped separator beneath it and to the right.

pressure at which xylene boils at 240 deg. F. Thus, a single organic compound permits a wide range of temperatures through adjustment of the pressure conditions in the vapor drying chamber. This flexibility, coupled with the fact that a large number of commercially available organic liquids with widely-varying boiling points are satisfactory for use in the vapor drying process, extends the available temperature range considerably.

concentration by the large volume of incoming dry organic vapor.

Reduces checking.

Results of vapor drying unseasoned red oak crossties have been essentially the same in both pilot and commercial plants. The reduction in the number, size and extent of the seasoning checks in vapor dried ties has been outstanding, compared with air-seasoned stock. This difference is apparent as soon as

A charge of T-C vapor dried, creosoted red oak crossties as they came from the pilot plant in 1943 before installation in test track on the Asheville division of the « Southern ».

Since the application of the vapor drying process involves exposing the wood to an atmosphere that does not attack it, an atmosphere which will not cause deterioration by oxidation because no oxygen is present; and, because that atmosphere is virtually free from steam that might cause deterioration by hydrolysis, the drying process can be carried on in the relatively high range between 212 and 400 deg. F., without injuring the wood. The only steam present in the drying atmosphere is that produced by distilling water from the wood, and hydrolysis is prevented because the steam is kept at a low

the ties are removed from the treating cylinder at the conclusion of preservative treatment. Furthermore, two years' service in test track in the main line of the Asheville division of the Southern have shown that the same differential has been maintained; in fact, the contrast between comparative groups that were treated and subsequently inserted in track at the same time was even more marked after two years' service.

Actual records show that unseasoned red oak crossties can be conditioned for preservative treatment in 14 hours or less by vapor seasoning, compared with 15 months average minimum time for

air seasoning on Taylor-Colquitt's Spartanburg yard. Further experimental tests now nearing completion indicate that it will be possible to accomplish the drying even in a period substantially less than 14 hr. During that period of a year and a quarter, air seasoning reduces the average moisture content from 70 per cent to about 40 per cent, but the process also is accompanied by considerable checking and splitting, which is an inherent characteristic of air-seasoned red oak ties.

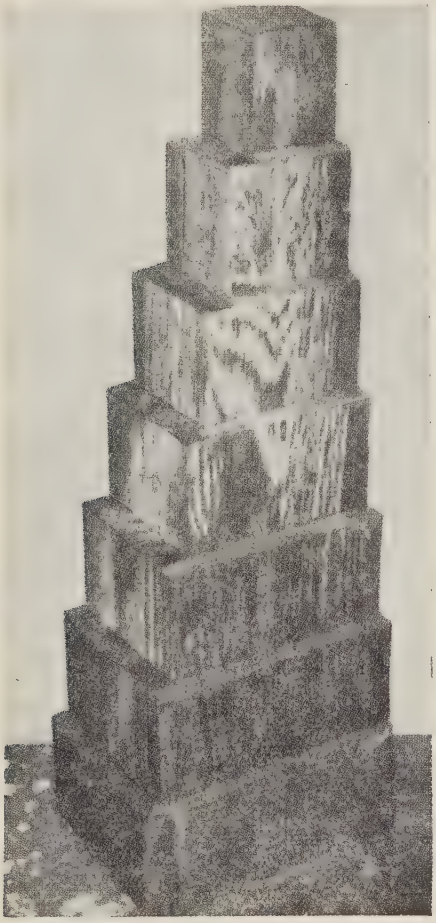
A charge of air seasoned, creosoted red oak crossties treated in the pilot plant in 1943, prior to their installation in Asheville division test track. The checking is typical of red oak crossties air seasoned in the Spartanburg area.

On the other hand, vapor dried ties emerge from the treating cylinders of both pilot and commercial plants with fewer checks than air-seasoned ties whose moisture content has been reduced to the same relative extent. Cross sections cut from vapor dried ties reveal small slits beginning $^1/_4$ in. or $^1/_2$ in. from the surfaces, extending inward along many of the medullary rays and ranging from $^3/_4$ in. to $1^1/_2$ in. in length, and varying in proportion to the length of the drying period. Rarely are these slits wider than $^1/_{16}$ in., nor have they been found within 2 in. of the ends of the ties.

Because of the presence of these ray-like slits, strength tests were conducted on vapor dried ties at the Southern Railway's laboratory at Alexandria, Va., and also at Clemson College, Clemson, S. C. Results revealed that vapor drying of unseasoned red oak ties at temperatures ranging from 320 to 330 deg. F., and employing a non-polar coal tar fraction with a boiling point within that range at atmospheric pressure, to reduce the average moisture content from 70 per cent to 30 per cent, was accompanied by reductions in strength of approximately 15 per cent, compared with unseasoned control ties. Similar conditioning reduced the strength of red and black gum ties by amounts ranging from two to eight per cent and reduced the strength of beech ties by approximately eight per cent.

To overcome strength reduction resulting from vapor seasoning, a modifi-

cation of the procedure was developed by exposing ties to alternating periods of heating vapors and vacuum instead of maintaining a prolonged heating period followed by the drawing of a final vacuum. The use of the alternating cycle treatment maintains a more uniform moisture gradient and eliminates the formation of small slits that characterize straight cycle conditioning. Strength tests have proved that ties dried by the alternating cycle are as strong as their unseasoned controls (i.e., green ties of the same species, from the same territory and cut at the same time). Alternating cycle vapor dried ties were not only free from internal slits as they were removed from the cylinder but were also as free from external or surface checks as similar ties treated by the straight cycle. Strange as it may seem, however, two years of service in test track revealed a striking difference, for while they had not checked as extensively as air-seasoned ties, they had developed more checks and splits than ties that had been conditioned by the straight cycle process.



A section of a 7-in. by 9-in. by 8-ft. 6-in. red oak crosstie, vapor dried by the straight cycle and treated with 60/40 creosote-coal-tar solution to 8-lb. retention, step-cut to show penetration of the preservative.

The fact that straight-cycle vapor dried creosoted red oak and hardwood crossties developed virtually no checks, even after two years of track service, is attributed to the development of small internal slits or checks during straight-cycle drying. These many small slits serve to equalize the stresses that otherwise develop in normal ties from swelling and shrinking of the wood during air seasoning, which involves alternate periods of wetting and drying. Because the small slits developed in straight cycle vapor drying relieve the ties of stresses, they prevent the progressive development of large localized checks and splits that usually appear in ordinary ties during service. Two-year service tests indicate that ties that have been stress-relieved by straight cycle internal checking, despite an initial 15 per cent reduction in strength, will give better service than relatively stronger ties that have been vapor dried by alternating the heating and vacuum cycles, but which have not been « stress relieved ».

Speeds lumber drying.

The potentialities of the T-C vapor drying process are not necessarily con-

fined to drying timber preparatory to preservative treatment, for the process also may be used advantageously for drying lumber. Compared to kiln-drying, the T-C process is much faster and presents an added advantage of removing resins that otherwise are very detrimental to paint coatings. The hot organic liquids that are used in vapor drying acts as solvents in removing resinous and other extractives that prevent good bonding of paint coats, and which, if not removed or treated, usually « bleed » through the paint and discolor its surface.

Lumber may be dried and impregnated with preservatives simultaneously by employing certain preservatives as organic drying agents, or by using other preservatives in conjunction with other drying agents. In wood preservative treatment the proper retention of preservative may be controlled by varying the intensity or the duration of the vacuum period that normally is used to recover the drying agent from the wood at the end of the drying cycle.

[**691.** (06 (.73) & **625** .143 (06 (.73)]

Large A.S.T.M. meeting held at Buffalo.

(From *The Railway Age.*)

Climaxing one of the busiest years in its history, the American Society for Testing Materials held its forty-ninth annual convention at the Statler hotel, Buffalo, N. Y., on June 24-28. Included in the extensive program was the presentation of more than 150 technical papers and committee reports, which were grouped according to allied or related subjects for consideration at the various technical sessions. The meeting assumed increased importance this year in the light of the reconversion program now in progress throughout the country, and the attendant need for the effective utilization of materials and production facilities.

Indicative of the intense interest in the work of the society is the fact that, despite housing difficulties, a total of 1 825 members and guests registered at the meeting, an attendance surpassed only by the 2 063 registered at the annual meeting in New York in 1944. That the work accomplished at the current meeting was also at a peak is seen in the fact that approximately 50 new tentative standards were adopted, all representing new or recent work on the part of the committees. The annual meeting next year will be held at the Chalfonte-Haddon Hall, Atlantic City, N. J., on June 23-27.

This year's meeting, which was presided over by J. R. Townsend, president of the society and materials engineer, Bell Telephone Laboratories, comprised 24 technical sessions, in addition to the numerous committee and subcommittee group meetings. In conjunction with the meeting, the society also conducted its seventh exhibit of testing appliances and related equipment and its fifth annual photographic exhibit.

Most of the reports and many of the technical papers presented before the society were preprinted and distributed to members for written comment and discussion. This expedient, together with advance meetings of individual committees, made it possible for the work at the meeting to be carried on at

Photo courtesy of Carnegie-Illinois Steel Corp.

a fast pace, and many problems relating to materials and tests were considered. Among the subjects of special interest to the railroad industry were those pertaining to steel, wrought and cast iron, certain non-ferrous metals, bearings, corrosion, cement and concrete, timber, and water.

Fatigue tests of rail.

Among the matters considered at a technical session devoted to steel and

related subjects was a paper on *Fatigue tests of rail steel under compressive stress,* by R. S. Jensen and H. F. Moore, University of Illinois. This paper described tests that were conducted on T-shaped specimens cut from a rail web under stress cycles ranging from compressive stress to tensile stress 20 per cent as great as the compressive stresses.

When such specimens failed, the fractures were found to have started on the compression side, and the compressive stresses were about 78 per cent higher than stresses in specimens subjected to cycles of completely-reversed bending stress. Under completely reversed stress the fractures started on the tension side of the specimen. Reduced stresses at fracture resulted in tests of specimens with stamped lettersat the critical section on the compression side. Although shot-peening sets up longitudinal compressive stress in the unstamped specimens, the fatigue strength of shot-peened specimens was approximately 32 per cent greater than for specimens in which the surface of the compression side was left as rolled.

The report of the *Committee on steel* dealt with numerous changes detailed in the standard specifications for open hearth carbon-steel rail, and also the tentative specifications for heat-treated carbon and alloy-steel track bolts and nuts, and changes in the standard specifications for steel tie plates. All this work was carried on in close cooperation with the American Railway Engineering Association and an effort was made to have the actual requirements in the specifications of the two bodies coordinated so far as possible. These changes are to be made to bring the requirements in line with the latest practice and, concurrent with this action, war-time emergency provisions have been withdrawn.

The committee also accepted a proposed revised specification for multi-wear wrought-steel wheels. The changes made, it was explained, comprise a revision and combination of two existing specifications : one covering heat-treated wheels of three classes, and the other, a non-heat-treated grade. The new specification is expected to simplify ordering and production, and will bring the requirements substantially in line with those of the Association of American Railroads.

The report of the *Committee on steel* contained numerous recommendations. A partial list of the specifications effected by these recommendations follows :

New Tentative Standards.

Low-carbon nickel-steel plates for boilers and other pressure vessels.
Rolled carbon-steel locomotives frames.

Adoption of Tentative Standard as Standard.

Heat-treated carbon and alloy-steel track bolts and nuts.

Revision of Standards, Immediate Adoption.

Open-hearth carbon-steel rails.
Steel for bridges and buildings.
Boiler and firebox steel for locomotives.
Welded and seamless steel pipe.
Steel tie plates.
Carbon-steel plates for stationary boilers and other pressure vessels.
Lap-welded and seamless steel and lap-welded iron boiler tubes.
Structural steel for locomotives and cars.
Carbon-steel forgings for locomotives and cars.

Adoption as Standard of Tentative Revisions of Standards.

Steel for bridges and buildings.

Whitdrawal of Standards.

Carbon-steel and alloy-steel castings for railroads.

Reaffirmation of Standards.

Open-hearth steel girder rails of plain, grooved and guard types.
Low-carbon steel joint bars.
Medium-carbon steel joint bars.
High-carbon steel joint bars.
Quenched carbon-steel joint bars.
Soft steel track spikes.
Steel screw spikes.
Low-carbon steel track bolts and nuts.
Hot-worked, high-carbon steel tie plates.

Corrosion.

Because of the increasing use of corrosion-resistant steels in the railway field, a feature of special interest to railway men was a symposium on *Atmospheric weathering of corrosion-resistant steels*. Subjects discussed during this session included exposure tests on corrosion-resistant steel, in a paper by I. V. Williams and K. G. Compton, Bell Telephone Laboratories; atmospheric corrosion tests on corrosion-resistant steel, by Grant L. Snair, Jr., Allegheny Ludlum Steel Corporation; atmospheric corrosion tests on high-chromium steel, by W. O. Binder and C. M. Brown, Union Carbide & Carbon Research Laboratories; marine exposure tests of corrosion-resistant steel sheet, by W. H. Muchler, National Bureau of Standards; atmospheric corrosion tests of corrosion-resistant steel wires, by A. P. Jahn, Bell Telephone Laboratories; and corrosion-resistant steel for architectural and structural applications, by H. A. Grove, Republic Steel Corporation. The last-mentioned paper, among other things, related the favorable results of an inspection made of a modern railroad train constructed of corrosion-resistant steel. Another point stressed during the symposium was that steels containing substantial amounts of chromium are finding increased applications in fields where resistance to atmospheric corrosion is important, because of the passivating effect that chromium imparts to steel under oxidizing conditions.

Presented during a session on nonferrous metals and allied subjects was the report of the Committee on Copper and Copper Alloys, Cast and Wrought. Changes in specifications proposed by this committee included the withdrawal of emergency alternate provisions in the specifications for bronze castings for turntables and movable bridges and for bearing and expansion plates for fixed bridges. This committee also recommended revisions for immediate adoption in a number of standard specifications, included the following :

Copper plates for locomotive fireboxes.
Copper bars for locomotive staybolts.
Bronze castings in the rough for locomotive wearing parts.
Car and tender journal bearings, lined.
Rolled copper-alloy bearing and expansion plates for bridges and other structural uses.

Also presented during the session on non-ferrous metals was the report of the Committee on Light Metals and Alloys, Cast and Wrought, which included several recommendations regarding aluminum and aluminum-magnesium products. This committee submitted new tentative specifications for aluminum-alloy sheets and plates, aluminum-alloy drawn seamless tubing, and aluminum-alloy bars, rods and wire. This group also recommended the withdrawal of five tentative specifications, all of which are of either direct or indirect interest to railroads, including those for aluminum-alloy (duralumin) sheet and plate; aluminum sheet and plate; aluminum-manganese alloy sheet and plate; aluminum-alloy (duralumin) bars, rods, wire and shapes; and aluminum-magnesium chromium alloy sheet and plate.

Cement and masonry materials.

Information of interest to the railroads was presented in the form of various committee reports and papers during a session on cement, concrete, lime, refractories and other masonry materials. In its report, the Committee on Cement presented a method of test for air content of portland cement mortar, and a lean mortar bar test as a measure of the sulphate resistance of portland cement. It also discussed the effect of alkalies in portland cement on the durability of concrete and on volume changes in, and the soundness of, portland cement. This committee also submitted

several new tentative specifications and tests which have been accepted, including (1) a specification for portland blast-furnace slag cement, (2) a test for determining the fineness of portland cement by the air-permeability apparatus, and (3) a test for determining Darex-air-entraining agent for portland cement. The committee also recommended for immediate adoption revisions in the specifications for portland cement.

Also presented during the session on concrete was a paper by H. A. LaRue, University of Missouri, on *Modulus of elasticity of aggregates and its effect on concrete,* which outlined tests conducted regarding the durability of aggregates in concrete construction. According to Mr. LaRue, aggregates with high moduli of elasticity produce concrete with correspondingly higher moduli than do stones which exhibit lower values.

Tests of concrete.

In discussing the use of the dynamic modulus of elasticity in predicting the 28-day flexural strength of concrete, E. F. Preece, U. S. Engineer Office, declared that the so-called sonic analysis has been used extensively to measure the deterioration of the flexural strength of concrete specimens subject to freezing and thawing, and that it is equally useful in determining the increases in flexural strength of concrete specimens with age. When the dynamic modulus at different ages is plotted against the respective age in days, the resulting curves have a well-defined pattern. Once this pattern is determined, it is practical to estimate the 28-day dynamic modulus within fairly close limits when the specimen is but 10 to 12 days old. This estimated value can then be used to determine the probable 28-day flexural strength from the dynamic modulus-flexural strength relationship which has been shown to be essentially linear in character.

A symposium on procedures for making freezing-and-thawing tests of concrete, sponsored by the Committee on Concrete and Concrete Aggregates, afforded an opportunity for round-table discussion of the procedures used by different investigators in evaluating the durability of concrete. Following a paper by M. O. Withey, University of Wisconsin, there were ten short contributions by leading authorities. Topics discussed in detail included principal objectives in making freezing-and-thawing tests, test procedures, and methods used for evaluating the results of freezing-and-thawing (e. g., sonic methods, length changes).

Bituminous roofing materials.

During a session on bituminous materials and related subjects, the Committee on Bituminous Waterproofing and Roofing Materials recommended revisions in the tentative specifications for (1) asphalt roofing surfaced with powdered talc or mica; (2) asphalt roofing surfaced with coarse mineral granules; and (3) methods of sampling bituminous materials. Also, revision for immediate adoption were recommended in the standard specifications for wide selvage asphalt roofing surfaced with coarse mineral granules, and in those for asphalt siding surfaced with coarse mineral granules. In addition, it was recommended that the specification for asphalt shingles surfaced with coarse mineral granules be adopted as standard in place of tentative.

Reporting during a session on nonferrous metals and miscellaneous materials, the Committee on Wood, of which Dr. Hermann Von Schrenk, consulting timber engineer, is chairman, reported that it is either revising or plans to revise during the coming year the standard specifications for round timber

piles; structural wood joint and plank, beams, stringers, posts and timbers; and zinc chloride. The standard methods for testing small clear specimens of timber, for testing the specific gravity of creosote, and definitions of terms relating to timber are receiving similar consideration.

Among the papers presented during a symposium on fatigue was one by W. C. Lewis, Forest Products Laboratory, on *Fatigue of wood and glued wood construction,* which stated that an understanding of the fatigue behavior of wood and glued wood constructions has required the development of proper testing machines and testing procedures. Some of the techniques and test methods have been perfected and a significant number of tests have been made in bending, tension parallel to the grain, and shear, on specimens of wood, plywood and wood with glued joints. Tests to date indicate that failures of wood specimens in fatigue have exactly the same appearance as those of corresponding specimens in tested statically.

The report of the Committee of Water for Industrial Uses was largely a review of the activities of the several subcommittees handling this subject, but this report was supplemented by a report by the Joint Research Committee on Boiler Feedwater Studies. The committee recommended new tentative methods for testing dissolved oxygen in industrial waters; a revision of the tentative test for tendency of boiler water to cause embrittlement cracking of steel; and revisions for immediate adoption in the standard method of reporting results of analysis of industrial waters.

MONTHLY BIBLIOGRAPHY OF RAILWAYS[1]

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(NOVEMBER 1946)

[016. 385. (02]

I. — BOOKS.

In French.

1945 625 .28 (.44)
AILLEUL (M.).
Le matériel roulant des chemins de fer français.
Paris, Eyrolles, éditeur. 1 volume (16 × 25) de 302 p. 135 figures. (Prix : 350 fr. français.)

1945 69 (02
ARBEROT (E.).
Traité de constructions civiles.
Paris et Liége, Béranger, éditeur. 1 volume (14 × 22) 1 332 pages et 1 910 figures. (Prix : 315 fr. belges.)

1946 691
MPREDON (J.).
Le bois, matériau de la construction moderne.
Paris (6e), Dunod, éditeur, 92, rue Bonaparte. 1 vol. 3 × 21) de VI-158 pages, avec 28 figures. (Prix : bro-, 240 fr. français.)

1946 669 .1
ARPY (G.) & PINGAULT (P.).
Notions élémentaires de sidérurgie.
Paris, Gauthier-Villars, éditeur. 1 volume (16 × 25) de) pages, avec 80 figures. (Prix : 447 fr. français.)

1946 624
MARNEFFE (A.).
es constructions hyperstatiques. 2e édition.
Paris (6e), Dunod, éditeur, 92, rue Bonaparte. 1 vol. × 19) de 232 pages, 88 fig. (Prix : 350 fr. français.)

1944 621 .392
UIS (H.).
onférences sur la soudure à l'arc électrique appliquée constructions.
iége, édité par l'Association des Elèves des Ecoles ciales de l'Université. 1 vol. (21 × 27) de 227 pages 290 figures.

946 656 .25
HLER (Dr. Ing. K.).
a nécessité économique des installations de sécurité chemins de fer. (Traduit de l'allemand.)
ucerne, « Economie et Technique des Transports ». é à part de cette revue, fasc. nos 58/59 et 60/61. rochure (21 × 29.5) de 12 pages avec illustrations.

1946 656 .25
TUOT (R.).
Le problème de la signalisation ferroviaire et sa solution rationnelle.
Paris (6e), Dunod, éditeur, 92, rue Bonaparte. 1 vol. (16 × 25) de 126 pages avec 46 figures. (Prix : 280 fr. français.)

In English.

1946 621 .431 .72 (.73)
A set of five booklets on Diesel locomotives.
Scranton, Pa. : International Textbook Company. 584 pages (4 3/4 × 7 1/4 in.). Bound in fabrikoïd. Illustrated. (Price : $ 5.55.)

1946 385. (09 .1 (.42)
ALLEN (C. J.).
Titled Trains of Great Britain.
London, Jan Ollan, Limited, 282 Vauxhall Bridge Road, S. W. 1. (Price : 6 sh.)

1946 385. (09 (.42)
BARRINGTON TATFORD.
The story of British Railways.
London, Sampson Low, Marston & Co., Ltd. (Price : 21 sh.)

1946 623 (.42)
BOND (F. S.).
Standard military railway bridges.
London, « The Railway Gazette », 33, Tothill Street, Westminster, S. W. 1, 26 pages, illustrated. (Price : 5 sh.)

1946 621 .13 (09 (.42)
British locomotive types.
London, The Railway Publishing Company, Ltd., 33, Tothill Street, Westminster, S. W. 1. (Price : 8 sh.)

1946 656 .254 (.54)
CARTER (H. L.).
Control of railway traffic operations by telephone and teleprinter.
Technical paper No. 317. Published by the Railway Board, Government of India, Delhi (13 1/2 × 8 1/2 in.) Photographs and diagrams. (Price : Rs. 2 or 3 sh.)

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conly with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway ice », by L. WEISSENBRUCH, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

1946 **625 .144 .2 (.54)**
FENTON (J. M.).
Curve realignment on the East Indian Railway.
Technical paper No. 116. Government of India, Railway Board, Foolscap, 25 pages and 11 folding diagrams. (Price : Rs. 2 11.0 or 4 sh. 3 d.)

1946 **531. (02**
MAURER (E. R.), ROARK (R. J.) & WASHA (G. W.).
Mechanics for Engineers.
New York, John Wiley and Sons, Inc., 425 pages (5 1/2 × 8 1/4 in.), illustrated. (Price : $ 4.00).

1946 **385. (07 (.42)**
Railways Quiz : For railwaymen and railway lovers.
London, Transportation Press Limited, Tudor Chambers, N. 22. (Price : 1 sh.)

1946 **385. (07 (.42)**
Railway « Hows ».
London, Transportation Press Limited, Tudor Chambers, N. 22. (Price : 2 sh.)

1946 **385. (09 .2 (.42)**
WEBB (B.).
Locomotive engineers of the L. N. E. R.
London, Jan Allan, Limited, 282, Vauxhall Bridge Road, S. W. 1. (Price : 3 sh.)

1946 **621 .132 .1 (.42 + .73) & 625 .24 (.42 + .73)**
WILDISH (G. N.).
Engines of War.
London, Jan Allan, Limited, 282, Vauxhall Bridge Road, S. W. 1, 24 pages, illustrated (8 × 5 in.) Paper covers. (Price : 1 sh. 6 d. net.)

In Spanish.

1946 **385. (061**
CONGRESO PANAMERICANO DE FERROCARRILES
Asociacion Permanente.
Breve resena historica (Julio de 1946).
Buenos Aires, Paseo Colon, nº 185, 1 folleto (
18 paginas.

In Italian.

1945 **6**
SANTARELLA (A.).
Il cemento armato. Vol. II : **Applicazioni alle costr**
zioni civili e industriali. X ed. rifatta.
Milano, Ulrico Hoepli, editore. 1 vol. in-8° gran
di pag. XVI-576, con 492 figure nel testo. (Prezz
600 lire.)

1946 **6**
SANTARELLA (L.).
Il prontuario del cemento armato. XIV ed. amplia
Milano, Ulrico Hoepli, editore. 1 vol. di pag. XV
396 con 178 figure e 24 tabelle. (Prezzo : 250 lire.)

[**016. 385. (05**]

II. — PERIODICALS.

In French.

Annales des Ponts et Chaussées. (Paris.)

1946 **62. (01**
Annales des Ponts et Chaussées, janvier-février, p. 1.
MANDEL (J.). — La **torsion** plastique. (6 000 mots & fig.)

1946 **624 .51**
Annales des Ponts et Chaussées, mars-avril, p. 166.
BLAISE (P.). — Le calcul des **ponts suspendus** à poutre de rigidité par la méthode directe. (2 500 mots & tableaux.)

Annales des Travaux publics de Belgique. (Bruxelles.)

1946 **624 .2 & 691**
Annales des Travaux publics de Belgique, avril, p. 157 et juin, p. 299.
MAGNEL (G.). — **Béton précontraint.** Pratique du calcul des pièces isostatiques soumises à flexion simple. (12 000 mots & fig.)

1946 **656 .211 (.49**
Annales des Travaux publics de Belgique, juin, p. 3
LEMAIRE (C.-F.-B.). — Les **gares** de Bruges. (5
mots & fig.)

1946 **62. (01 & 6**
Annales des Travaux publics de Belgique, août, p. 413
FERET (R.). — Encore la relation entre les résistan
à la flexion et à la compression des **mortiers.** (1 500 m
& fig.)

Bulletin de la Société des Ingénieurs civils de France. (Paris.)

1946 **62. (01 &**
Bulletin de la Soc. des Ing. Civils de France, fascic
nos 17 et 18, p. 117.
GUILLET (L.). — Influence de la structure et de
composition des **alliages métalliques** sur les propri
élastiques. (1 500 mots.)

Bulletin des C. F. F. (Berne.)

1946 **621 .33 (.4**
Bulletin des C. F. F., nº 1, janvier, p. 9.
Electrification de la ligne Schaffhouse-Etzwilen.
mots & fig.)

1946 **621 .335 (.494)**
ılletin des C. F. F., nº 3, mars, p. 35.
MEYER (E.). — Les **premières locomotives C. F. F.** l'après-guerre. (3 500 mots & fig.)

1946 **625 .17 (.494)**
ılletin des C. F. F., nº 4, avril, p. 55 ; nº 5, mai, p. 72.
PORTMANN (M.). — **Entretien des installations** de emin de fer. (4 000 mots & fig.)

1946 **625 .172 (.494)**
ılletin des C. F. F., nº 4, avril, p. 62.
La prévention des accidents dans le **désherbage chi- que.** (600 mots.)

1946 **385 .61**
ılletin des C. F. F., nº 5, mai, p. 70.
ALIOTH (A.). — **L'unité technique des chemins de** r. L'échange des véhicules. (2 500 mots.)

1946 **621 .33 (.494)**
ılletin des C. F. F., nº 6, juin, p. 88.
Electrification de la ligne Romanshorn-Kreuzlingen. 00 mots & fig.)

1946 **625 .1 (.494)**
ılletin des C. F. F., nº 7, juillet, p. 110.
Amélioration à la ligne du Saint-Gothard. (1 200 mots fig.)

1946 **621 .33 (.494)**
ılletin des C. F. F., nº 9, septembre, p. 136.
L'électrification des lignes Palézieux-Payerne et Aarau- hr-Zofingue. (1 200 mots & fig.)

1946 **656 .254 (.494)**
ılletin des C. F. F., nº 10, octobre, p. 160.
FELBER (E.). — Les appareils d'**arrêt automatique** r le réseau C. F. F. (1 000 mots & fig.)

Bulletin des Transports internationaux par chemins de fer. (Berne.)

1944 **385 .113 (.494)**
ll. des transp. intern. par ch. de fer, juillet, p. 206.
La gestion et les comptes des Chemins de fer fédéraux ır 1943. (2 000 mots.)

1944 **656 .24 (.494)**
ll. des transp. intern. par ch. de fer, août, p. 223.
WEBER (K.-E.). — La **responsabilité civile du chemin fer** et les causes d'exonération en droit suisse. (5 000 ts.)

1945 **385 .63**
ll. des transp. intern. par ch. de fer, janvier, p. 2.
VOGEL (P.). — La réglementation du **trafic interna- nal des cadres ferroviaires** (containers). (6 000 mots.)

1945 **385 .63**
ll. des transp. intern. par ch. de fer, février, p. 37 ; mars, p. 65.
FAVRE (J.). — Du **recours de l'assureur** contre le nsporteur et spécialement contre le chemin de fer. 000 mots.)

1945 **385 .113 (.485)**
ll. des transp. intern. par ch. de fer, février, p. 62.
Les **chemins de fer suédois** en 1943. (1 000 mots.)

1945 **385 (.495)**
Bull. des transp. intern. par ch. de fer, mars, p. 87.
Le **réseau** des chemins de fer de Grèce. (1 200 mots.)

1945 **313 .385 (.494)**
Bull. des transp. intern. par ch. de fer, mars, p. 92.
Les **Chemins de fer fédéraux suisses** en 1943. (Tableaux.)

1945 **385 .113 (.489)**
Bull. des transp. intern. par ch. de fer, avril, p. 116.
L'exercice 1943/1944 des **Chemins de fer de l'Etat danois.** (1 100 mots.)

1945 **385 .6**
Bull. des transp. intern. par ch. de fer, mai, p. 121 ; juin, p. 153.
FRIEBE (K.). — Les **Conventions internationales** concernant le transport par chemins de fer, en tant que traités internationaux. L'essence des stipulations internationales. (11 000 mots.)

1945 **385 .113 (.492)**
Bull. des transp. intern. par ch. de fer, mai, p. 145.
Les **Chemins de fer néerlandais** en 1942 et 1943. (1 500 mots.)

1945 **385 .6**
Bull. des transp. intern. par ch. de fer, juin, p. 177.
Extrait du Rapport de gestion pour l'année 1944 de **l'Office central des transports internationaux par chemins de fer.** (1 300 mots.)

1945 **347 .763 .4 (.44)**
Bull. des transp. intern. par ch. de fer, juillet p. 185.
DURAND (P.). — La **législation française des trans- ports par fer** pendant la guerre. (5 000 mots.)

1945 **385 .63**
Bull. des transp. intern. par ch. de fer, août, p. 220 ; septembre, p. 253.
FRIEBE (K.). — Moment auquel, d'après la législation internationale des transports ferroviaires, le **droit de disposer de la marchandise** passe de l'expéditeur au destinataire. (9 000 mots.)

1945 **385 .113 (.494)**
Bull. des transp. intern. par ch. de fer, août p. 243.
Rapport sur la **gestion** et les **comptes** des Chemins de fer fédéraux pour 1944. (2 500 mots.)

Bulletin technique de la Suisse romande. (Lausanne.)

1946 **625 .113**
Bull. techn. de la Suisse romande, 17 août, p. 221 ; 31 août, p. 233.
DECOMBAZ (E.). — Exposé succinct de la méthode de **rectification des courbes de chemin de fer** d'après la mesure des flèches. (5 500 mots & fig.)

Génie Civil. (Paris.)

1943 **62. (01 & 669**
Génie Civil, nº 3116, 1er septembre, p. 196.
GUILLET (L.). — Le **durcissement structural** des produits métallurgiques et ses derniers progrès. (2 000 mots & fig.)

1943 **662 (.44)**
Génie Civil, n° 3116, 1er septembre, p. 200.
L'utilisation des **combustibles de remplacement** à la S. N. C. F. (1 000 mots.)

1943 **385 .524**
Génie Civil, n° 3118, 1er octobre, p. 222.
GOMBERT (G.). — La **participation des travailleurs aux résultats** des entreprises. (2 500 mots.)

1943 **691**
Génie Civil, n° 3118, 1er octobre, p. 224.
Les **traitements protecteurs** des surfaces métalliques. (1 300 mots.)

1943 **621 .33 (.44)**
Génie Civil, n° 3119, 15 octobre, p. 229; n° 3120, 1er novembre, p. 246.
Le projet d'**électrification** de la grande ligne de Paris à Lyon de la Société Nationale des Chemins de fer français. (6 000 mots & fig.)

1943 **669 .1**
Génie Civil, n° 3119, 15 octobre, p. 235.
MERKLEN (J.) & VALLOT (E.). — L'**acier au carbone** et son emploi dans les matériels de chemins de fer. (1 500 mots.)

1943 **624 .51**
Génie Civil, n° 3121, 15 novembre, p. 256.
BATICLE (E.). — Les **ponts suspendus** à auto-ancrage. (2 000 mots & fig.)

1945 **621 .135 .2 (.73)**
Génie Civil, n° 3158, 1er juin, p. 86.
La fabrication des **essieux creux pour locomotives,** à la Pittsburgh Steel Co. (500 mots.)

1945 **621 .137 (.42)**
Génie Civil, n° 3161, 15 juillet, p. 111.
L'**éclairage électrique des locomotives** en Angleterre. (500 mots & fig.)

1945 **621 .33 (.44)**
Génie Civil, n° 3165, 15 septembre, p. 139.
L'**électrification** de la ligne de Paris à Sète par Toulouse. Achèvement du dernier tronçon Brive-Mantauban. (2 800 mots & fig.)

1945 **625 .13 (.44)**
Génie Civil, n° 3167, 15 octobre, p. 153; n° 3168, 1er novembre, p. 164.
LOSSIER (H.). — L'utilisation de ciments expansifs pour la réparation et la **reconstruction d'ouvrages d'art** sinistrés. (4 300 mots & fig.)

1945 **621 .13 (.42)**
Génie Civil, n° 3167, 15 octobre, p. 158.
L'activité des ateliers anglais de **construction de locomotives** en 1944. (800 mots & fig.)

1945 **621 .132 .8 (.43)**
Génie Civil, n° 3169, 15 novembre, p. 182.
La **locomotive allemande à condensation** 150-E-21. (700 mots & fig.)

1945 **623 (.44) & 656 .212 .5 (.44)**
Génie Civil, n° 3170, 1er décembre, p. 185.
MACHEFERT-TASSIN (Y.). — La **reconstruction des gares** de Tours et de Saint-Pierre-des-Corps. (4 000 mots & fig.)

1946 **625 .22 (.4**
Génie Civil, n° 3172, 1er janvier, p. 9.
Pantographe pour la vérification du **gabarit d ouvrages d'art** employé sur le Southern Railway. (4 mots & fig.)

1946 **625 .13 (.4**
Génie Civil, n° 3173, 15 janvier, p. 17.
LEVI (R.) & FOUGEA (E.). — La **réparation viaduc** en fonte sur le Rhône entre Tarascon et Bea caire. (2 500 mots & fig.)

Mécanique
(Bulletin de la Société française des Mécaniciens) (Paris).

1946 **665 .882 & 669**
Mécanique, juillet, p. 165; août, p. 199.
VILEZ (M.). — La **trempe superficielle au cha meau.** (8 500 mots, tableaux & fig.)

1946 **621 .4**
Mécanique, août, p. 191.
LEDUC (M.). — Le démarrage hydraulique **moteurs à combustion interne.** (5 000 mots & fig.)

1946 **621**
Mécanique, septembre, p. 229.
MARTINET (P.). — L'application des principes **graissage** dans l'industrie. Erreurs d'élaboration mécanismes. (9 000 mots & fig.)

L'Ossature métallique. (Bruxelles.)

1946 **623 (.44) & 624 .7 (.4**
L'Ossature métallique, juillet-août, p. 151.
GONON (R.). — La **reconstruction du pont** de Choi le-Roi. (1 600 mots & fig.)

1946 **624 .7 (.4**
L'Ossature métallique, juillet-août, p. 155.
BÜHLER (F.). — Le **pont soudé** des Chemins de fédéraux suisses, sur la Birs, près de Bärschwil. (1 mots & fig.)

1946 **725 .33 (.**
L'Ossature métallique, juillet-août, p. 159.
Les nouveaux **ateliers de réparations** des Chemins fer L. M. S. (600 mots & fig.)

1946 **623 (.492) & 624 .32 (.4**
L'Ossature métallique, juillet-août, p. 163.
ROMEIJN (H.-G.). — La **reconstruction du pont Moerdijk** (Pays-Bas). (1 300 mots & fig.)

1946 **691 (.4**
L'Ossature métallique, juillet-août, p. 169.
VAN DER VEEN (H.). — Dix années d'**essais corrosion** atmosphérique en Hollande. (6 000 mots & f

1946 **624**
L'Ossature métallique, juillet-août, p. 179.
ROBERT (E.) & MUSETTE (L.). — Le nouv système belge de **poutre de pont.** (10 000 mots & fig.

1946 **624 .32 (.**
L'Ossature métallique, septembre-octobre, p. 203.
LEDUC (O.). — Construction d'un **pont semi-pr soire** à Chalampé (France). (4 000 mots & fig.)

1946 **624 .62 (.438)**
Ossature métallique, septembre-octobre, p. 214.
Reconstruction du pont Prince Joseph Poniatowski, à rsovie. (1 200 mots & fig.)

1946 **624 .6**
Ossature métallique, septembre-octobre, p. 231.
ENYEDI (B.). — Influence de la rigidité de la superucture d'une **construction en arc.** Méthode approximae de calcul. (7 000 mots, tableaux & fig.)

Revue de l'Aluminium (Paris).

1946 **621 .431 .72 (.44)**
vue de l'Aluminium, avril, p. 120.
VICTOR (M.). — La **Micheline « 136 ».** (5 000 mots ig.)

Revue générale des chemins de fer. (Paris.)

1944 **621 .132 .5 (.42)**
vue générale des chemins de fer, mai-juin, p. 68.
La locomotive de guerre des Chemins de fer anglais. 0 mots.)

1944 **621 .135 & 625 .21**
vue générale des chemins de fer, juillet-août, p. 73.
DENAVARRE (J.). — Une nouvelle méthode de **cul des caisses de locomotives** également applicable **caisses de voitures, automotrices et fourgons.** (10 000 s & fig.)

944 **656 .23 (0**
ue générale des chemins de fer, juillet-août, p. 85.
IERMET. — Les nouveaux **tableaux de distances** de S. N. C. F .(3 000 mots & fig.)

944 **656 .254 (.44)**
ue générale des chemins de fer, juillet-août, p. 90.
ORTEJOIE. — Le nouveau **poste de commandement** Nancy. (3 000 mots & fig.)

944 **621 .131 .3 (.44)**
ue générale des chemins de fer, septembre-octobre, p. 97.
OHL (G.). — **Essai au banc** de Vitry de la locomo- à vapeur type Mikado série 141-P de la S. N. C. F. 00 mots & fig.)

944 **656 .235 (.44)**
ue générale des chemins de fer, septembre-octobre, p. 104.
ELASSUS & FRANÇOIS. — La **nouvelle tarification létail** de la S. N. C. F. (2 500 mots & fig.)

944 **656 .225 (.44) & 656 .261 (.44)**
ue générale des chemins de fer, septembre-octobre, p. 108.
UGUET. — Les **Services extérieurs de la Région ienne** (S. E. R. P.). (6 000 mots & fig.)

944 **621 .138 .5 (.44) & 621 .7 (.44)**
ue générale des chemins de fer, septembre-octobre, p. 116.
chantier de régulage du dépôt de Tours. (1 000 mots g.)

1944 **621 .331 (.44)**
Revue générale des chemins de fer, n° 6, novembre-décembre, p. 121.
VILLENEUVE. — **Electrification** de la ligne Brive-Montauban. Ligne d'alimentation à haute tension et sous-stations. (3 500 mots & fig.)

1944 **656 .23 (.44)**
Revue générale des chemins de fer, n° 6, novembre-décembre, p. 127.
BIDET. — Étude des indices de majoration des **tarifs voyageurs et marchandises** depuis 1913. (3 000 mots & fig.)

1944 **621 .131 .1**
Revue générale des chemins de fer, n° 6, novembre-décembre, p. 137.
BOHL (G.). — Perfectionnement au **relevé des diagrammes de cylindres** des locomotives à vapeur par un « indicateur cinématographique ». (1 800 mots & fig.)

1945 **656 .256 .2 (.44)**
Revue générale des chemins de fer, janvier-février, p. 1.
Le **block manuel unifié** sur les lignes à double voie de la S. N. C. F.
CHARZAT. — Le programme « exploitation ».
DUBOUDIN. — La description et le fonctionnement.
MICHAUX. — Les conditions de réalisation des premiers équipements. (6 000 mots & fig.)

1945 **625 .22**
Revue générale des chemins de fer, janvier-février, p. 11.
MAZZONE (J.). — Appareil pour le calcul des **déplacements des véhicules en courbe.** (2 800 mots & fig.)

1945 **625 .233**
Revue générale des chemins de fer, janvier-février, p. 15.
DURAND (M.). — L'**éclairage par fluorescence** des voitures à voyageurs. (2 500 mots & fig.)

1945 **625 .251 & 625 .253**
Revue générale des chemins de fer, janvier-février, p. 20.
Détermination du poids-frein des véhicules de chemins de fer munis du frein à air comprimé. (1 300 mots & fig.)

Science et Vie. (Paris.)

1946 **621 .33 (.44)**
Science et Vie, août, p. 75.
MARCHAND (J.). — L'**électrification** des Chemins de fer français. (2 500 mots & fig.)

La Technique moderne. (Paris.)

1946 **621 .9**
La Technique moderne, nos 13 et 14, 1er et 15 juillet, p. 137.
Les **nouveautés industrielles** en 1946 (machines-outils). (15 000 mots & fig.)

1946 **621 .438**
La Technique moderne, nos 17 et 18, 1er et 15 septembre, p. 193; nos 19 et 20, 1er et 15 octobre, p. 217.
CHAMBADAL (P.). — La **turbine à combustion.** Ses différents cycles thermiques. (7 000 mots & fig.)

In German.

Archiv für Eisenbahnwesen. (Berlin.)

1942 **313 : 656 .2 (.73) & 313 : 656 .9 (.73)**
Archiv für Eisenbahnwesen, November/Dezember, S. 919.
STEUERNAGEL. — **Pipelines und Eisenbahnen** der U. S. A. im Spiegel der Statistik. (5 500 Wörter & Tafeln.)

1942 **656 .225 (.65)**
Archiv für Eisenbahnwesen, November/Dezember, S. 935.
WERNEKKE. — **Frühgemüse** und **Frühobst** aus Algerien. (3 500 Wörter.)

1943 **385 .1 (.481)**
Archiv für Eisenbahnwesen, Januar-Februar, S. 1.
PASZKOWSKI (Fritz). — **Eisenbahnpolitik** Norwegens. (50 000 Wörter, Tafeln & 1 Karte.)

1943 **385 .517 (.43)**
Archiv für Eisenbahnwesen, Heft 2, März-April, S. 165.
HAUSTEIN (W.). — Fragen der allgemeinen und betrieblichen **Sozialpolitik** bei der Reichsbahn. (28 000 Wörter.)

1943 **625 .6 (.92)**
Archiv für Eisenbahnwesen, Heft 2, März-April, S. 247.
REITSMA (S. A.). — Die **60 Zentimeter-Schmalspurbahnen** für den öffentlichen Verkehr in Niederländisch-Indien. (20 000 Wörter & 2 Karten.)

1943 **385 .63**
Archiv füt Eisenbahnwesen, Heft 2, März-April, S. 291.
WYSZOMIRSKI. — Der Einfluss des Krieges auf den Geltungsbereich des **Internationalen Übereinkommens über den Eisenbahnfrachtverkehr.** (6 000 Wörter.)

1943 **385. (09 .3 (.47)**
Archiv für Eisenbahnwesen, Heft 3, S. 349.
SALLER (H.). — **Geschichte** der russischen Lokomotivbau-, Wagenbau- und Schienenindustrie. (11 000 Wörter.)

1943 **656 .28**
Archiv für Eisenbahnwesen, Heft 3, S. 373.
KRÖNER. — Ansprüche von Hinterbliebenen bei **Eisenbahnunfällen.** (20 000 Wörter.)

1943 **385 .113 (.492)**
Archiv für Eisenbahnwesen, Heft 3, S. 457.
OVERMANN. — Die **Finanzen** der Niederländischen Eisenbahnen im Jahre 1941. (5 000 Wörter & Tafel.)

Der Bahn-Ingenieur. (Berlin.)

1941 **621 .138 .5 (.43) & 625 .26 (.43)**
Der Bahn-Ingenieur, Nr. 27, 6. Juli, S. 317.
SCHÄFER. — Vom **Wenden der Radsätze** beim Ab- und Aufreifen und von der Radsatzwendevorrichtung Bauart Nied. (3 500 Wörter & Abb.)

1941 **625 .143 .5**
Der Bahn-Ingenieur, Nr. 28, 13. Juli, S. 329.
LORENZ. — **Warum wandern die Eisenbahnschienen ?** (1 200 Wörter & Abb.)

1941 **625 .1**
Der Bahn-Ingenieur, Nr. 28, 13. Juli, S. 333.
RAUSCHER. — **Weichenverbindungen** an nicht para lelen Weichen. (1 000 Wörter & Abb.)

1941 **625 .151 & 625 .1**
Der Bahn-Ingenieur, Nr. 28, 13. Juli, S. 335.
Weichenheizung. (400 Wörter & Abb.)

1941 **625 .232 (.4**
Der Bahn-Ingenieur, Nr. 29, 20. Juli, S. 341.
Einbettschlafwagen der Mitropa in Zügen der Deu schen Reichsbahn. (1 700 Wörter & Abb.)

1941 **625 .144**
Der Bahn-Ingenieur, Nr. 29, 20. Juli, S. 346.
Vereinfachte Berechnungen zur geschwungenen **Übe höhungsrampe.** (1 200 Wörter, 2 Tafeln & Abb.)

1941 **621 .392 (.43) & 721 .9 (.4**
Der Bahn-Ingenieur, Nr. 30, 27. Juli, S. 353.
SAHLING (B.). — Änderungen der Vorschriften be **Schweissen von Stahlbauten.** (6 000 Wörter 5 Taf & Abb.)

1941 **62. (**
Der Bahn-Ingenieur, Nr. 31, 3. August, S. 365; Nr. 10. August, S. 377.
Die **Rückbleibe** (Remanenz oder Hysteresis). (4 0 Wörter & Abb.)

1941 **621 .135 .2 & 625 .2**
Der Bahn-Ingenieur, Nr. 33, 17. August, S. 389.
MENGLER. — Verfahren und Vorrichtungen z **Ausdrehen von Lagerschalen für Dünnguss.** (1 600 W ter & Abb.)

1941 **625 .142**
Der Bahn-Ingenieur, Nr. 34, 24. August, S. 408.
WEBER (F.). — **Eisenbetonquerschwellen.** (800 W ter & Abb.)

1941 **625 .142**
Der Bahn-Ingenieur, Nr. 35, 31. August, S. 413.
STEINWEDE. — Die **Holzschwelle** im Kriege. (3 Wörter, Tabellen & Abb.)

1941 **625 .27 (.**
Der Bahn-Ingenieur, Nr. 36, 7. September, S. 425.
HOFFMANN (O.). — Das Tauschverfahren bei **Fahrzeugerhaltung.** (2 000 Wörter.)

1941 **625 .173 (.**
Der Bahn-Ingenieur, Nr. 37, 14. September, S. 437.
HAUN. — Ursache und Behebung eines **Dau rutsches.** (1 300 Wörter & Abb.)

1941 **62. (01 & 691 (.**
Der Bahn-Ingenieur, Nr. 39, 28. September, S. 461.
LANGNER (K.). — Die deutschen **Textilrohstoffe** ihre Verwendung bei der Reichsbahn. (6 800 Wö & Abb.)

1941 **625 .14**
Der Bahn-Ingenieur, Nr. 40, 5. Oktober, S. 477.
KIRCHHOFF. — **Berechnung der Ausgleichschi und der Stossmitten** auf dem äusseren Lehrschienenst in Gleisbogen. (2 000 Wörter & 1 Zusammenstellung.)

1941 **621 .13**
Der Bahn-Ingenieur, Nr. 41, 12. Oktober, S. 489.
KOCH (K.). — **Windleitbleche** an Lokomotiven. (1 Wörter & Abb.)

1941 **536 & 62.** (08
er Bahn-Ingenieur, Nr. 41, 12. Oktober, S. 491.
Oberflächen- und Eintauchpyrometer. (800 Wörter
Abb.)

1941 **625 .174 (.43)**
er Bahn-Ingenieur, Nr. 41, 12. Oktober, S. 497.
Bekämpfung von **Schneeverwehungen.** (800 Wörter.)

Elektrische Bahnen. (Berlin.)

1942 **621 .331**
lektrische Bahnen, Heft 11, November, S. 240; Heft 12, Dezember, S. 252.
DRAEGER (W.). — Neue **Quecksilberdampf-Eisen-eichrichter** für Bahnanlagen. (3 500 Wörter & Abb.)

1942 **654 (.43) & 621 .33 (.43)**
lektrische Bahnen, Heft 12, Dezember, S. 243.
MANN (K.). — Die **Fernbedienungsanlage für die romversorgung** der Hamburger S-Bahn. (7 000 Wörter Abb.)

1942 **621 .33 (.485)**
lektrische Bahnen, Heft 12, Dezember, S. 256.
THELANDER (T.). — Die schwedische Staatsbahn-ektrisierung. Einige Angaben, zusammengestellt aus nlass des vollendeten **Ausbaues** der nördlichen Stamm-ahn **auf elektrischen Betrieb.** (3 000 Wörter & Abb.)

1943 **621 .33 (.437)**
lektrische Bahnen, Heft 1, Januar, S. 3.
VIEST (I.). — Die **Elektrisierung** der Slowakischen isenbahnen. (3 500 Wörter & Abb.)

1943 **621 .33 (.437)**
lektrische Bahnen, Heft 1, Januar, S. 8.
OKRUCKY (J.). — **Elektrisierung** der Strecke Zilina-oisska Nova Ves. (2 000 Wörter, 2 Zusammenstellun-en & Abb.)

1943 **621 .33**
lektrische Bahnen, Heft 1, Januar, S. 17.
WECHMANN (W.). — Der **elektrische Zugbetrieb** auf istungsfähigen Fernbahnen. (14 000 Wörter & Abb.)

1943 **621 .332**
lektrische Bahnen, Heft 2, Februar, S. 33.
WEINRATH (H.). — Über die **Energieversorgungs-öglichkeiten** von 16 2/3 Hz-Bahnanlagen. (10 000 Wör-r, 6 Tafeln & Abb.)

1943 **385. (072 (.43) & 621 .33 (.43)**
lektrische Bahnen, Heft 3, März, S. 53.
KASPEROWSKI (O.). — 10 Jahre **Elektrotechnisches ersuchsamt** der Reichsbahn. (6 000 Wörter & Abb.)

1943 **621 .332**
lektrische Bahnen, Heft 3, März, S. 60; Heft 4/5, April-Mai, S. 84.
WILKE (G.). — Der Einfluss des Warmverhaltens on **Fahrleitungen** auf ihre Grenzbelastbarkeit. (5 000 örter, Zahlentafeln & Abb.)

Glasers Annalen. (Berlin.)

1942 **625 .214**
lasers Annalen, Heft 15, 1. August, S. 164.
RESSMANN (H.). — **Hochleistungsachslager für chienenfahrzeuge** im Lichte der Kriegswirtschaft. (3 400 örter & Abb.)

1942 **621 .43**
Glasers Annalen, Heft 16, 15. August, S. 173.
FOEDISCH (F.). — Die Kraftversorgung und der Betrieb von **Verbrennungsmotoren** in diesem Kriege. (4 000 Wörter & Abb.)

1942 **621 .134**
Glasers Annalen, Heft 16, 15. August, S. 179.
NAUMANN (F.). — Zur **Kondensationsfrage** bei Schnellfahrlokomotiven. (3 000 Wörter & Abb.)

1942 **623 & 625 .112**
Glasers Annalen, Heft 17, 1. September, S. 188; Heft 22, 15. November, S. 253.
DOST (O.). — Militärische **Spurweiten.** (6 500 Wörter & Tafel.)

1942 **621 .3 & 621 .8**
Glasers Annalen, Heft 18, 15. September, S. 197.
SCHIEBELER (C.). — Elektrische Ausrüstungen für **Krane und Fördergeräte.** (6 500 Wörter & Abb.)

1942 **669**
Glasers Annalen, Heft 19, 1. Oktober, S. 209; Heft 20, 15. Oktober, S. 221.
HÖLTJE (H.). — Die neuzeitliche **Härtetechnik** unter besonderer Berücksichtigung der elektrischen Öfen. (10 000 Wörter & Abb.)

1942 **621 .136 (.43)**
Glasers Annalen, Heft 19, 1. Oktober, S. 213.
WOLFF (Ad.). — **Untergestellfreie Leichtbautender.** (2 500 Wörter, 1 Zusammenstellung & Abb.)

Die Lokomotive. (Bielefeld-Berlin.)

1942 **621 .13 & 669 .1**
Die Lokomotive, Nr. 9, September, S. 143.
SCHNEIDER (L.). — **Izett-Stähle im Lokomotivbau.** (1 000 Wörter & Abb.)

1942 **621 .131**
Die Lokomotive, Nr. 9, September, S. 145.
HEISE (G.). — Verfahren zur überschlägigen Ermittlung der **Kessel- und Maschinenleistung** vorhandener oder neu entworfenen Heissdampflokomotiven an Hand von Schaulinien. (2 400 Wörter, 4 Tafeln & Abb.)

1942 **621 .135 .4 & 625 .215**
Die Lokomotive, Nr. 10, Oktober, S. 161; Nr. 11, November, S. 185.
HEUMANN. — Der Einfluss der Radreifenkegelform auf den **Bogenlauf** von steifachsigen Eisenbahnfahrzeugen. (11 000 Wörter & Abb.)

1942 **385. (07 .4 (.436)**
Die Lokomotive, Nr. 11, November, S. 179.
RIHOSEK (J.). — Der Lokomotiv- und Wagenbau im historischen **Eisenbahnmuseum** in Wien. (1 500 Wörter & Abb.)

1942 **621 .13 (09 (.43)**
Die Lokomotive, Nr. 12, Dezember, S. 197.
METZELTIN. — Deutschland führt im **Lokomotiv-bau.** (8 000 Wörter & Abb.)

1943 **621 .131 .1**
Die Lokomotive, Nr. 1, Januar, S. 1.
NEESEN (F.). — Vom **Wirkungsgrad der Lokomotiven.** (3 500 Wörter & Abb.)

1943 **621 .134 .2**
Die Lokomotive, Nr. 1, Januar, S. 7.
FARMAKOWSKY (W.). — Mitnehmer und Lenkerstange bei **Heusinger-Steuerung.** (900 Wörter & Abb.)

1943 **621 .132 .8 (093**
Die Lokomotive, Nr. 1, Januar, S. 11.
Die Geschichte der **Fell-Lokomotive.** (1 200 Wörter & Abb.)

1943 **621 .132 .8 (.55)**
Die Lokomotive, Nr. 2, Februar, S. 19.
ROOSEN (R.). — Henschel-**Kondenslokomotive** für die Irakischen-Staatsbahnen. (1 300 Wörter & Abb.)

1943 **621 .133 .8 (.43)**
Die Lokomotive, Nr. 2, Februar, S. 22.
WALLSTAB (Otto). — Der Wagner-**Heissdampf-Ventilregler.** (2 700 Wörter & Abb.)

1943 **621 .132 .8 (.43)**
Die Lokomotive, Nr. 3, März, S. 37.
MEYER (E.). — **Feuerlose Lokomotiven** mit geschweisstem Kessel. (2 300 Wörter & Abb.)

1943 **656 .254 (.43)**
Die Lokomotive, Nr. 3, März, S. 46.
PENSCHKE (Otto). — Die induktive **Zugbeeinflussung.** (3 200 Wörter & Abb.)

1943 **621 .132 .8 (.494) & 621 .438 (.494)**
Die Lokomotive, Nr. 4, April, S. 57.
GÜNTHER. — Die erste **Gasturbinen-Lokomotive.** (1 500 Wörter & Abb.)

1943 **621 .131**
Die Lokomotive, Nr. 4, April, S. 61.
METZELTIN. — Die **Dampflokomotive** eine fahrbare Kraftanlage. (2 400 Wörter & Abb.)

1943 **385 .587 (.43)**
Die Lokomotive, Nr. 5, Mai, S. 75.
BRÜGMANN (G.). — Die Bestimmung der wirtschaftlichen Zerspannungsgrössen bei der **Planung von Drehe-Arbeiten.** Ein Beitrag zur **Leistungssteigerung im Lokomotivbau.** (5 000 Wörter, Tafeln & Abb.)

1943 **621 .335 (.494)**
Die Lokomotive, Nr. 5, Mai, S. 89.
LIECHTY (R.). — **Neue Lokomotiven** der S. B. B. (1 000 Wörter & Abb.)

Organ für die Fortschritte des Eisenbahnwesens. (Berlin.)

1941 **621 .135. (01, 625 .14 (01 & 625 .212**
Organ für die Fortschritte des Eisenbahnwesens, Heft 21, 1. November, S. 333; Heft 22, 15. November, S. 349.
LEVEN (Werner). — Die **Reibung zwischen Rad und Schiene.** (17 000 Wörter, 5 Tafeln & Abb.)

1941 **625 .154 (.43)**
Organ für die Fortschritte des Eisenbahnwesens, Heft 24, 15. Dezember, S. 381.
NIEDERSTRASSER (L.). — Die Vereinheitlichung der **Lokomotivdrehscheiben** der Deutschen Reichsbahn. (7 000 Wörter, Abb. & Tafeln.)

1941 **621 .13 & 656 .222 .1**
Organ für die Fortschritte des Eisenbahnwesens, Heft 24, 15. Dezember, S. 388.
MARTIN (O.). — **Schnellzuglokomotiven** für hohe Geschwindigkeiten. (5 500 Wörter, 3 Zahlentafeln & Abb.)

1942 **625 .215**
Organ für die Fortschritte des Eisenbahnwesens, Heft 1, 1. Januar, S. 1.
HEUMANN. — Lauf von **zweiachsigen steifachsigen Treibfahrzeugen** in der Geraden. (6 500 Wörter & Abb.)

1942 **621 .135. (01**
Organ für die Fortschritte des Eisenbahnwesens, Heft 1, 1. Januar, S. 10.
NÖTHEN (J.). — Die **Anpassung von Lokomotiven** mit grösseren Feder- und Ausgleichhebelsystemen an windschiefes Gleis. (3 000 Wörter, Tabelle & Abb.)

1942 **385 (.47)**
Organ für die Fortschritte des Eisenbahnwesens, Heft 2, 15. Januar, S. 21.
SALLER (H.). — Die **Sowjeteisenbahnen.** (3 000 Wörter, 1 Karte & Abb.)

1942 **621 .431 .72 (.83)**
Organ für die Fortschritte des Eisenbahnwesens, Heft 2, 15. Januar, S. 24.
ZIELKE (G.). — Einsatz von **Dieseltriebzügen** in Chile. (5 000 Wörter & Abb.)

1942 **656 .257 (.43)**
Organ für die Fortschritte des Eisenbahnwesens, Heft 3, 1. Februar, S. 37.
KROEBEL (E.). — Die Entwicklung zu einer **neuen Stellwerksbauart** bei der Hamburger U-Bahn. (5 500 Wörter & Abb.)

1942 **62. (01 & 624 .**
Organ für die Fortschritte des Eisenbahnwesens, Heft 3, 1. Februar, S. 44.
WEYGANDT. — Der photoelektrische **Schwingweg-messer.** (3 000 Wörter & Abb.)

1942 **625 .14 (.01 & 625 .4**
Organ für die Fortschritte des Eisenbahnwesens, Heft 4, 15. Februar, S. 53.
ZELLER (W.). — Beiträge zur **Erschütterungs- und Schalldämmung bei der Eisenbahn,** insbesondere bei der U-Bahn, mit Rücksicht auf die Verkehrsnachbarschaft. (4 500 Wörter, 2 Tabellen & Abb.)

1942 **385. (09 (.47 .42 + 47. 43 + 47 .5**
Organ für die Fortschritte des Eisenbahnwesens, Heft 4, 15. Februar, S. 59.
WERNEKKE. — Die **Eisenbahnen** der Ostsee-Randstaaten Litauen, Lettland und Estland. (6 000 Wörter & Karte.)

1942 **621 .431 .72 (.4**
Organ für die Fortschritte des Eisenbahnwesens, Heft 4, 15. Februar, S. 66.
Der **Verbrennungsmotor** bei den europäischen Eisenbahnen unter besonderer Berücksichtigung der Triebwagen. (1 500 Wörter.)

942 625 .172 (.43)
an für die Fortschritte des Eisenbahnwesens, Heft 5, 1. März, S. 69.
VOLF (H.). — Der **Oberbaumesswagen** der Deutn Reichsbahn in verbesserter Form. (5 000 Wörter bb.)

942 625 .215
an für die Fortschritte des Eisenbahnwesens, Heft 6, 15. März, S. 85.
on WALDSTÄTTEN. — Neue **Drehgestellkonstruken.** (3 000 Wörter & Abb.)

942 625 .245
an für die Fortschritte des Eisenbahnwesens, Heft 6, 15. März, S. 89.
EHRSPAN (K.). — 25 Jahre **Kübelwagen.** (1 500 ter & Abb.)

942 385. (09 .3 (.43)
an für die Fortschritte des Eisenbahnwesens, Heft 6, 15. März, S. 93.
CHULZE-MANITIUS (H.). — Die **Entwicklung** des schen Eisenbahnnetzes. (6 000 Wörter & Bild.)

Die Reichsbahn. (Berlin.)

944 625 .244 (.43)
Reichsbahn, Heft 12-13, 22./29. März, S. 63.
ITSCH (B.). — Neue **Kühlwagen** der Deutschen hsbahn. (1 500 Wörter & Abb.)

944 621 .33 (.43)
Reichsbahn, Heft 20-22, 17./24./31. Mai, S. 119.
RIENITZ (G.). — 65 Jahre **elektrischer Zugbetrieb.** 00 Wörter & Abb.)

944 385 .113 (.43)
Reichsbahn, Heft 25-26, 21./28. Juni, S. 149.
eschäftsbericht der Deutschen Reichsbahn über das häftsjahr 1943 (1. Januar bis 31. Dezember 1943). 00 Wörter & 2 Tafeln.)

weizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik. (Zürich.)

946 385 .113
eizerisches Archiv für Verkehrswissenschaft und Verkehrspolitik, Nr. 3, S. 243.
EYER (Dr. H. Reinhard). — Vom volkswirtschaftn **Aufwand für den Verkehr.** (11 000 Wörter bellen.)

itschrift des Vereines deutscher Ingenieure. (Berlin.)

41 662
chrift des Vereines deutscher Ingenieure, Nr. 26, 8. Juni, S. 571.
NEULE (F.). — **Oktanzahl** und **Kraftstoffbewertung** ahrbetrieb. (9 000 Wörter, 4 Zahlentafeln & Abb.)

41 629 .113 .4 & 662
chrift des Vereines deutscher Ingenieure, Nr. 27, . Juli, S. 591.
NKBEINER (H.). — **Fahrzeug-Gaserzeuger** für eie Brennstoffe und Gasreinigungsanlagen. (7 500 er, 1 Tafel & Abb.)

1941 62. (01
Zeitschrift des Vereines deutscher Ingenieure, Nr. 27, 5. Juli, S. 605.
BERG (S.). — Zur Technik des **Schwingerversuchs.** (2 200 Wörter & Abb.)

1941 62. (01 & 721 .1
Zeitschrift des Vereines deutscher Ingenieure, Nr. 28, 12. Juli, S. 625.
FÖPPL (L.). — Elastische Beanspruchung des Erdbodens unter Fundamenten. (1 000 Wörter & Abb.)

1941 62. (01 & 691
Zeitschrift des Vereines deutscher Ingenieure, Nr. 30, 26. Juli, S. 647.
GRAF (O.). — Herstellung von **Beton** mit bestimmten Eigenschaften. Stand der Forschung und weitere Aufgaben. (5 000 Wörter & Abb.)

1941 62. (01 & 691
Zeitschrift des Vereines deutscher Ingenieure, Nr. 30, 26. Juli, S. 658.
Widerstandsfähigkeit von Baustoffen und Bauteilen **gegen Feuer und Wärme.** (1 600 Wörter & Abb.)

1941 624 (.43)
Zeitschrift des Vereines deutscher Ingenieure, Nr. 35/36, 6. September, S. 747.
SCHAECHTERLE (K.). — **Brückenbauten** für die Reichsautobahnen. (800 Wörter & Abb.)

1941 62. (01 & 669
Zeitschrift des Vereines deutscher Ingenieure, Nr. 39/40, 4. Oktober, S. 793.
GLOCKER (R.), LUTZ (W.) & SCHAABER (O.). — Nachweis der Ermüdung wechselbeanspruchter Metalle durch Bestimmung der Oberflächenspannungen mittels Röntgenstrahlen. (7 000 Wörter, 5 Zahlentafeln & Abb.)

1941 621 .82
Zeitschrift des Vereines deutscher Ingenieure, Nr. 39/40, 4. Oktober, S. 801.
MUNDT (R.). — Zur Berechnung der **Tragfähigkeit von Wälzlagern.** (6 000 Wörter & Abb.)

1941 62. (01
Zeitschrift des Vereines deutscher Ingenieure, Nr. 41/42, 18. Oktober, S. 829.
TROST (A.). — Die Anwendung des Zählrohrs in der **zerstörungsfreien Werkstoffprüfung.** (4 600 Wörter & Abb.)

1941 621 .132 .3 (.43)
Zeitschrift des Vereines deutscher Ingenieure, Nr. 41/42, 18. Oktober, S. 836.
Schnellzuglokomotiven der Reichsbahn. (400 Wörter.)

1941 621 .436
Zeitschrift des Vereines deutscher Ingenieure, Nr. 41/42, 18. Oktober, S. 842.
ZINNER (K.). — Aufspritzen des Kraftstoffes im **Dieselmotor.** (1 600 Wörter & Abb.)

1941 621 .392 & 624
Zeitschrift des Vereines deutscher Ingenieure, Nr. 41/42, 18. Oktober, S. 843.
ALBERS (K.). — **Schrumpfungen** und Schrumpfspannungen bei Baustellenstössen **geschweisster Brückenträger.** (1 500 Wörter & Abb.)

1941 **62. (01 & 721 .9**
Zeitschrift des Vereines deutscher Ingenieure, Nr. 43/44, 1. November, S. 871.
Die Prüfung der **Betonfestigkeit** im Bauwerk. (800 Wörter.)

1941 **623 (.44)**
Zeitschrift des Vereines deutscher Ingenieure, Nr. 45/46, 15. November, S. 891.
STOY (W.). — **Brückenbauten** deutscher Eisenbahnpioniere in Frankreich 1940. (1 800 Wörter & Abb.)

1941 **625 .245**
Zeitschrift des Vereines deutscher Ingenieure, Nr. 49/50, 13. Dezember, S. 953.
GOEPEL (E.). — **Eisenbahnwagenkipper** mit Druckölantrieb. (2 100 Wörter & Abb.)

In English.

Bulletin, American Railway Engineering Association. (Chicago.)

1942 **621 .431 .72 (.73)**
Bulletin, Amer. Railway Engineering Assoc., No. 435, December, p. 229.
Report of Committee 6. **Buildings.** Progress report on design of **fueling facilities for Diesel locomotives.** (3 400 words.)

1942 **621 .138 .5 (.73) & 621 .431 .72 (.73)**
Bulletin, Amer. Railway Engineering Assoc., N. 435, December, p. 235.
Report of Committee 6. **Buildings.** Design of **shop facilities for Diesel locomotives.** (6 000 words & fig.)

1943 **624 .2 (.73)**
Bulletin, Amer. Railway Engineering Assoc., No. 439, June-July, p. 1.
Impact investigation of a plate girder bridge. (7 200 words, tables & fig.)

1943 **625 .14 (01 & 625 .2 (01**
Bulletin, Amer. Railway Engineering Assoc., No. 440, September-October, p. 1.
Progress in the **Study of the relation of track and rolling stock.** (900 words.)

1943 **625 .14 (01 & 625 .2 (01**
Bulletin, Amer. Railway Engineering Assoc., No. 440, September-October, p. 3.
ALLEMAN (N. J.). — Studies of the pressure as affected by the area of **contact between wheel and rail.** (1 400 words & tables.)

1943 **621 .135 .(01**
Bulletin, Amer. Railway Engineering Assoc., No. 440, September-October, p. 9.
MAGEE (G. M.) & CRESS (E. E.). — Investigation of the **impact effect of flat wheels.** (4 000 words, tables & fig.)

1943 **624 .2**
Bulletin, Amer. Railway Engineering Assoc., No. 440, September-October, p. 25.
WILSON (W. M.). — **Fatigue failure** in its relationship to strengthening and repair of steel bridge members. (5 000 words.)

Engineer. (London.)

1946 **621 .13 (.4**
Engineer, No. 4711, April 26, p. 374; No. 4712, May p. 398.
NOCK (O. S.). — **British locomotive working** wartime. (3 600 words & fig.)

1946 **656 .25 (.4**
Engineer, No. 4729, August 30, p. 189.
Overhaul of signal relays. (960 words & fig.)

1946 **621 .131**
Engineer, No. 4730, September 6, p. 202; No. 47 September 13, p. 227; No. 4732, September p. 248.
HOLCROFT (L.). — **Condensing by compressio** a locomotive experiment. (8 400 words & fig.)

1946 **625 .112 (.4**
Engineer, No. 4731, September 13, p. 232.
Parliament and the **rail gauge question.** (2 400 word

1946 **621 .335 (.4**
Engineer, No. 4732, September 20, p. 251.
Lötschberg Railway's **Bo-Bo electric locomoti** (2 400 words & fig.)

1946 **621 .431 .72 (.44) & 656 .212 .5 (.**
Engineer, No. 4733, September 27, p. 285.
Diesel-electric shunting locomotives for the S. N. C (240 words & fig.)

1946 **621 .13 (.**
Engineer, No. 4735, October 11, p. 314.
NOCK (O. S.). — **Present-day locomotive working** Great Britain. (3 000 words & fig.)

Great Western Railway Magazine. (London

1946 **625 .143 .1 (.42) & 625 .144 .4 (.**
Great Western Railway Magazine, October, No. p. 213.
More about **flat bottom rails.** Relaying with 60-ft plete lengths of pre-assembled track. (800 words &

Journal and Proceedings, Institution of Mechanical Engineers. (Lond

1946 **62.**
Proceedings, Institution of Mechanical Engineers, vol. (War Emergency Issue No. 13).
SUTON PIPPARD (A. J.). — **Stresses** by ana and experiment. (18 000 words, tables & fig.)

1946 **62**
Proceedings, Institution of Mechanical Engineers, vol (War Emergency Issue No. 14).
CLAYTON (D.). — An exploratory study o grooves in **plain bearings.** (4 000 words, tables & fi

1946 **62**
Proceedings, Institution of Mechanical Engineers, vol (War Emergency Issue No. 14).
FOGG (A.). — **Fluid film lubrication** of parallel t surfaces. (8 000 words, tables & fig.)

1946 **62.** (01

oceedings, Institution of Mechanical Engineers, vol. 155 (War Emergency Issue No. 15).

KEARTON (W. J.). — The calculation of the **stresses a turbine wheel** by the method of superposition. (6 000 rds, tables & fig.)

1946 **621 .116**

oceedings, Institution of Mechanical Engineers, vol. 155 (War Emergency Issue No. 15).

GIFFEN (E.) & CRANG (T. F.). — **Steam flow in zzles:** velocity coefficient at low steam speeds. (8 000 rds, tables & fig.)

---

ournal, Institution of Civil Engineers. (London.)

1946 **62** (01

urnal, Institution of Civil Engineers, No. 8, October, p. 486.

TAYLOR (G. E.). — The **testing of materials** at high es of loading. (10 000 words, tables & fig.)

1946 **621 .138 .5**

urnal, Institution of Civil Engineers, No. 8, October, p. 539.

JONES (A. L.). — **Revolving locomotive boilers** about eir horizontal axes in order to attain, from time to ne, in the course of **repairs**, the most convenient wor- ng position. (240 words & fig.)

---

ournal, Permanent Way Institution. (London).

1946 **625 .143 .3**

urnal, Permanent Way Institution, vol. 64, part 1, April, p. 46.

DINSDALE (C.). — **How rails break.** (11 000 words, bles & fig.)

The Locomotive. (London.)

1946 **385.** (09 (.44)

ie Locomotive, No. 648, August 15, p. 126.

CLARKE (J. T.). — Further french recollections. 00 words & fig.)

1946 **621 .132 .1 (.42)**

ie Locomotive, No. 649, September 14, p. 133.

British steam locomotives, 1945. (900 words & table.)

1946 **621 .13 (09 (.42)**

ie Locomotive, No. 649, September 14, p. 140.

ABBOTT (P. A. S.). — The **broad-gauge locomotives** the Vale of Neath Railway. (1 000 words & fig.)

1946 **621 .138 .5 (.42)**

ie Locomotive, No. 650, October 15, p. 150.

Tractors at Crewe Works, L. M. S. R. (780 words fig.)

Mechanical Engineering. (New York.)

1946 **621 .133 .3 (.73)**

echanical Engineering, April, p. 369.

A. S. M. E. Boiler Code. Proposed revisions and denda to **boiler construction code.** (3 000 words.)

Modern Transport. (London.)

1946 **621 .335 (.494)**

Modern Transport, March 2, p. 11.

New Swiss express locomotives. Double bogie electric units for lightweight interurban service. (1 200 words & fig.)

1946 **656 .211 .5 (.42)**

Modern Transport, March 9, p. 11.

Improvements to railway stations. L. N. E. R. code of practice. (2 400 words & fig.)

1946 **656 .211 .5 (.42)**

Modern Transport, March 9, p. 15.

New ticket-issuing machine. T. I. M. model incorporates sixteen improvements. (700 words & fig.)

1946 **621 .132 .5 (.4)**

Modern Transport, March 16, p. 3.

Liberation locomotives built in Britain. New Vulcan design for European service. (1 900 words & fig.)

1946 **656 .281 (.42)**

Modern Transport, March 16, p. 9.

Derailment by engine failure. A broken big-end. Report on the Carcroft accident. (2 000 words.)

1946 **385 .52**

Modern Transport, March 16, p. 15.

CROPPER (R.). — **Unfair competition.** Influence of wages rates. (1 500 words.)

1946 **385 & 625 .1**

Modern Transport, March 16, p. 17; March 30, p. 15.

Unorthodox railway construction. (2 200 words.)

1946 **656 (.41)**

Modern Transport, March 23, p. 3.

Co-ordination of transport in Eire. (1 700 words & fig.)

1946 **625 .23 (.73)**

Modern Transport, March 23, p. 5.

Recent American railway coaches. (1 400 words & fig.)

1946 **621 .132 .5 (.73)**

Modern Transport, March 30, p. 3.

POULTNEY (E. C.). — **American non-articulated steam locomotives of high power.** New York Central 4-8-4 type; Pennsylvania 2-10-4 type. Extra large capacity tenders. (1 200 words & fig.)

1946 **656 .281 (.42)**

Modern Transport, March 30, p. 5.

A question of sun-dazzle. The Bourne End **derailment.** (2 400 words.)

1946 **656 .254 (.42)**

Modern Transport, April 6, p. 3.

Train control on the Cheshire lines. Handling heavy traffic increases. (3 200 words & fig.)

1946 **625 .232 (.73)**

Modern Transport, April 13, p. 20.

American **dining cars.** Illinois Central kitchen layout. (400 words & fig.)

1946 **385 .15 (.42) & 656 (.42)**

Modern Transport, April 20, p. 5.

Controlled freedom for road and rail. An alternative to nationalisation. (2 400 words.)

1946 **625 .26 (.42) & 725 .33 (.42)**
Modern Transport, April 20, p. 17.
Engineering shops for L. N. E. R. at Sheffield. Layout of rebuilt premises. (900 words & fig.)

1946 **385. (09 (.492)**
Modern Transport, April 27, p. 17.
Belgian Railway system. Reconstruction going ahead. (700 words.)

Railway Age. (New York.)

1946 **621 .138 .5 (.73) & 621 .431 .72 (.73)**
Railway Age, April 6, p. 714.
Diesel shops on Santa Fe coast line. (5 000 words & fig.)

1946 **656 .254 (.73)**
Railway Age, April 6, p. 725.
Joint operation **aided by C. T. C.** (1 400 words & fig.)

1946 **625 .13 (.73)**
Railway Age, June 29, p. 1258.
Repairs Kingwood Bore by **novel methods.** (2 200 words & fig.)

1946 **625 .243 (.73)**
Railway Age, June 29, p. 1265.
« Pacemaker » **box cars** fitted for speed. (1 200 words & fig.)

1946 **621 .133 .3**
Railway Age, July 6, p. 5.
All-welded locomotive boilers. (1 100 words & fig.)

1946 **656 .231 (.42)**
Railway Age, July 6, p. 9.
LLOYD WILSON (G.). — « **Agreed charges** » prove popular in Britain. (6 500 words & tables.)

1946 **725 .31 (.73)**
Railway Age, July 13, p. 48.
Small town **station goes ultra-modern.** (1 700 words & fig.)

1946 **621 .133 .4 (.73)**
Railway Age, July 13, p. 51.
Elimination of locomotive smoke. (3 200 words & fig.)

1946 **625 .24 (.73)**
Railway Age, July 13, p. 59.
Barber stabilized **truck.** (300 words & fig.)

1946 **625 .234 (.73)**
Railway Age, July 20, p. 97.
MUNKELT (F. H.). — Air purification in **conditioned railway passenger cars.** (550 words & fig.)

1946 **621 .431 .72 (.73)**
Railway Age, July 27, p. 126.
Union Pacific places first **F-M road Diesel** in regular service. (2 800 words & fig.)

1946 **656 .256 .3 (.73)**
Railway Age, July 27, p. 134.
Automatic block with spring switches. (2 200 words & fig.)

1946 **624 .63 (.73**
Railway Age, August 3, p. 167.
Replaces **bridge** across Sandusky Bay. (4 800 word & fig.)

1946 **625 .233 (.73**
Railway Age, August 3, p. 176.
SCHEPMOES (L.). — Plastics for **railway car ligh ing.** (800 words & fig.)

1946 **625 .213 (.73**
Railway Age, August 3, p. 183.
Passenger-car **air springs** tested. (600 words & fig.)

Railway Engineering and Maintenance. (Chicago.)

1941 **625 .162 (.73**
Railway Engineering and Maintenance, December, p. 88
Highway crossings of laminated wood. (1 400 word & fig.)

1942 **625 .154 (.73**
Railway Engineering and Maintenance, January, p. 10
Novel track layout obviates necessity of new **turntabl** (700 words & fig.)

1942 **625 .144 .4 (.73**
Railway Engineering and Maintenance, March, p. 18
Rio Grande shows the way with **off-track equipmen** (7 000 words & fig.)

1942 **625 .144 .4 (.73**
Railway Engineering and Maintenance, March, p. 19
Union Pacific relaid 475 miles of new rail in 19 with **mechanized gangs** and without delays to traffi (2 800 words & fig.)

1942 **625 .143 .4 (.73**
Railway Engineering and Maintenance, March, p. 28
Flame-cleans rail ends when **renewing joint ba** (1 400 words & fig.)

1942 **625 .144 .4 (.73**
Railway Engineering and Maintenance, July, p. 469.
Trackmaster develops novel **automatic gage.** (1 0 words & fig.)

1942 **621 .133 .7 (.73**
Railway Engineering and Maintenance, July, p. 473.
Foaming — its causes and methods of control. (2 1 words & fig.)

1942 **625 .143**
Railway Engineering and Maintenance, Novembe p. 813.
Rail fastenings on bridges, pits and turntables. (10 0 words & fig.)

1942 **625 .13 (.7**
Railway Engineering and Maintenance, Novembe p. 827.
The **repair of steel bridges.** (4 200 words & fig.)

Railway Gazette. (London.)

1946 **625 .242 (.4**
Railway Gazette, No. 19, May 10, p. 511.
Coal and its post-war carriage on British railwa (2 600 words.)

1946 **621 .132 .3 (.42)**
ilway Gazette, No. 19, May 10, p. 516.
Rebuilt « K 4 » class 2-6-0 locomotive, L. N. E .R.
)0 words & fig.)

1946 **625 .1 (.42)**
ilway Gazette, No. 19, May 10, p. 522.
London railway departmental committee's £ 230.000.000 n. New North-South lines in deep-level tunnels. 100 words & map.)

1946 **621 .132 .3 (.489)**
ilway Gazette, No. 20, May 17, p. 543.
Danish **Atlantics rebuilt as Pacifics.** (500 words & fig.)

1946 **625 .232 (.42)**
ilway Gazette, No. 20, May 17, p. 544.
Golden Arrow » all-plastic **bar car.** (300 words & fig.)

1946 **656 .22 (.73)**
ilway Gazette, No. 21, May 24, p. 567.
Fast luxury travel in America. (1 600 words.)

1946 **621 .132 .4 (.42)**
ilway Gazette, No. 21, May 24, p. 570.
Conversion of L. N. E. R. class « B 17 » locomotive.
)0 words & fig.)

1946 **625 .13 (.42)**
ilway Gazette, No. 21, May 24, p. 572.
Rebuilding Coker viaduct L. M. S. R. (400 words ig.)

1946 **656 .256 .3 (.494)**
ilway Gazette, No. 22, May 31, p. 596.
FELBER (E.). — **Automatic signalling** in Switzerland. 200 words & fig.)

1946 **621 .132 .8 (.73)**
ilway Gazette, No. 22, May 31, p. 598.
Geared steam turbine locomotive, Pennsylvania RR. 300 words & fig.)

1946 **656 .25 (.42)**
ilway Gazette, No. 22, May 31, p. 602.
L. M. S. R. **signal lamp tests** in wind tunnel. (200 rds & fig.)

1946 **656 .285 (.42)**
ilway Gazette, No. 22, May 31, p. 606.
Ministry of War Transport accident report. At Brow- Signal box, L. N. E. R.: January 5, 1946. (3 500 rds & fig.)

1946 **625 .245 (.42)**
ilway Gazette, No. 22, May 31, p. 608.
Transport of roadstone by rail L. M. S. R. **coated dstone wagon.** (450 words & fig.)

Railway Magazine. (London.)

1946 **621 .13 (.42) & 656 .222 .1 (42)**
lway Magazine, No. 565, September-October, p. 277.
ALLEN (Cecil J.). — British **locomotive practice and formance.** (2 600 words & table.)

1946 **621 .132 .3 (.42)**
lway Magazine, No. 565, September-October, p. 284.
MARTIN (Gavin P. B.). — The « **Lord Nelson** » **class,** thern Railway. (1 400 words & fig.) (To be conti- d.)

Railway Mechanical Engineer. (New York.)

1945 **621 .132 .1 (.73)**
Railway Mechanical Engineer, December, p. 569.
Western Maryland Shay. (2 000 words & fig.)

1945 **621 .133 .3 (.73)**
Railway Mechanical Engineer, December, p. 590.
Factors affecting cinder cutting of boilers. (8 000 words & fig.)

1946 **621 .132 .5 (.73)**
Railway Mechanical Engineer, January, p. 1.
P. R. R. Q-2 locomotives. (2 400 words & fig.)

1946 **625 .23 (.73)**
Railway Mechanical Engineer, January, p. 5; February, p. 65.
Passenger cars — 1946 models. (3 200 words & fig.)

1946 **621 .133 .3 (.73)**
Railway Mechanical Engineer, January, p. 24.
Tubes and flues. (1 750 words & fig.)

1946 **621 .436 (.73)**
Railway Mechanical Engineer, February, p. 55.
Seabord 3 000-Hp. Diesel. (4 800 words & fig.)

In Spanish.

Boletin de la Asociacion Internacional Permanente del Congreso Sudamericano de Ferrocarriles. (Buenos-Aires.)

1945 **624 .63 (.82)**
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles. noviembre-diciembre, p. 15.
NOYA SCHOO (C.). — **Puente internacional** sobre el Rio Uruguay entre Paso de Los Libres y Uruguayana. (3 000 palabras & fig.)

1945 **385. (06 (.8)**
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles, noviembre-diciembre, p. 25.
NUNEZ BRIAN (J.). — V^e **Congreso panamericano de ferrocarriles.** (1 500 palabras.)

1946 **313 .385 (.3)**
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles, enero-febrero, p. 29.
BARRES (F.). — **Longitud de las vias ferreas** de la Argentina y las de capital britanico en el mundo. (1 300 palabras & graficos.)

1946 **656 .222 .1**
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles, enero-febrero, p. 40.
GRINDLEY (H. H.). — **El factor velocidad** en el transporte ferroviario. (6 000 palabras.)

1946 **385 .113 (.82)**
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles, enero-febrero, p. 87.
Resultados de la explotación en el año 1944 de los Ferrocarriles del Estado argentino. (1 200 palabras & cuadros.)

1946 **385.** (061 .6
Boletin de la Asoc. intern. perm. del Congreso Sudameric. de Ferrocarriles, marzo-junio, p. 17.
El V^e **Congreso Panamericano de Ferrocarriles,** celebrado en Montevideo. (150 paginas, con cuadros.)

Ferrocarriles y Tranvias. (Madrid.)

1943 **624** .63 (.460)
Ferrocarriles y Tranvías, junio, p. 150.
JOSE FERNANDEZ-PRIDA Y G. MENDOZA. — **Reconstrucción del puente** sobre el rio Agueda. (2 000 palabras & fig.)

1943 **621** .131 .3
Ferrocarriles y Tranvías, junio, p. 158.
NAVARRO GIL (L.). — El **vagón dinamométrico** y los problemas ferroviarios. (3 000 palabras & fig.)

1943 **621** .131
Ferrocarriles y Tranvías, junio, p. 165.
PEDRERO (F.). — La elección de **nuevas locomotoras.** (1 500 palabras.)

1943 **621** .131 .1
Ferrocarriles y Tranvías, julio, p. 186.
VILLAR (M.). — Juicio crítico sobre el articulo « Algunas consideraciones sobre el aumento de **potencia especifica de las locomotoras ».** (1 000 palabras & fig.)

1943 **656** .225 (.43) & **656** .261 (.43)
Ferrocarriles y Tranvías, julio, p. 190.
Transporte de 500 000 vagones sobre calles y carreteras. (2 500 palabras & fig.)

1943 **656** .281
Ferrocarriles y Tranvías, agosto, p. 210.
LAFFITTE MARTINEZ (C.). — Teoria del **descarrilamiento.** (3 000 palabras & fig.)

1943 **625** .17 (.494)
Ferrocarriles y Tranvías, agosto, p. 222.
BIANCHI (A.). — La **conservación de la via** en Suiza durante la guerra. (1 600 palabras.)

1943 **625** .14 (01
Ferrocarriles y Tranvías, septiembre, p. 244.
REYNOLDS (L.). — Condiciones que debe reunir la **via** para soportar velocidades elevadas. (3 000 palabras.)

1943 **621** .33 (.45)
Ferrocarriles y Tranvías, septiembre, p. 249.
La **linea principal** de las comunicaciones ferroviarias en Italia. (2 000 palabras.)

Revista de Obras Públicas. (Madrid.)

1944 **691** (.460) & **721** .9 (.460)
Revista de Obras Publicas, n° 2751, 1 de julio, p. 369.
Instrucción para el proyecto de **obras de hormigón.** (9 000 palabras & fig.)

1946 **385.** (072 (.460)
Revista de Obras Publicas, n° 2778, octubre, p. 450.
MENDIZABAL (D.). — Nuevo **laboratorio de investigaciones ferroviarias.** (2 000 palabras.)

Revista del Colegio de Ingenieros de Venezuel (Caracas-Venezuela.)

1942 **624**
Revista del Colegio de Ingen. de Venezuela, julio-agost setiembre, p. 297.
OLIVARES (A. E.). — Carga eliptica en las **viga** (600 palabras & fig.)

1943 **721**
Revista del Colegio de Ingen. de Venezuela, jul diciembre, p. 77.
FERULANO (P. E.). — **Placas de concreto arma** con armadura cruzada. (5 000 palabras, tablas & fig.)

Revista del Consejo Administrativo de los F.F. C.C. Nacionales. (Bogota.)

1940 **385** .113 (.8
Revista del Consejo adminis. de los F. F. C. C. nac nales, enero-junio, p. 952.
Resultados en la explotacion de los Ferrocarriles Nac nales en 1939 y primer trimestre del presente año. (C dros.)

1941 **385.** (09 (.8
Revista del Consejo adminis. de los F. F. C. C. nac nales, febrero, p. 1175.
CAMACHO (G.). — **Ferrocarriles colombianos.** Parte Informacion general. — Parte II: Ferrocarriles Nac nales de Colombia. (150 paginas con figuras, ma & cuadros.)

1941 **385** .113 (.8
Revista del Consejo adminis. de los F. F. C. C. na nales, marzo-junio, p. 1332.
Resultados de explotacion de los Ferrocarriles Na nales y demas empresas que estan a cargo del Cons Administrativo de los mismos en 1940. (135 paginas cuadros.)

1942/43/44/45 **385** .113 (.
Revista del Consejo adminis. de los F. F. C. C. na nales, julio-diciembre 1941, p. 1471; enero-diciem 1942, p. 1651; enero-diciembre 1943, p. 1835; en diciembre 1944, p. 2015.
Resultados de explotacion de los Ferrocarriles Na nales y demas empresas que estan a cargo del Con Administrativo de los mismos, durante los años de 1 1942, 1943 y de 1944. (Cuadros.)

In Italian.

Giornale del Genio Civile (Roma).

1945 **62.** (01 & 72
Giornale del Genio Civile, novembre-dicembre, p.
ASTUNI (E.). — Nota sul progetto della **sez rettangolare in cemento armato,** sollecitata a fless semplice secondo uno degli assi principali. (1 000 pa tavole & fig.)

1946 **624**
Giornale del Genio Civile, maggio-giugno, p. 201.
KRALL (G.). — Statica ed aerodinamica del **p sospeso** ad una fune o ad un arco molto sottile. (C nuazione e fine.) (5 000 parole & fig.)

946 625 .113
rnale del Genio Civile, maggio-giugno, p. 285.
IARESCA (G.). — Su un metodo di **tracciamento le curve stradali** definite dalla loro equazione natu-
1
— = f (s). (1 500 parole & fig.)
ρ

---

ngegneria ferroviaria — Rivista dei Transporti. (Roma.)

946 621 .131 .2
egneria ferroviaria, agosto-settembre, p. 45.
ORBELLINI (G.). — **Sui limiti costruttivi delle loco-tive.** (4 500 parole & fig.)

---

946 625 .143 .4
egneria ferroviaria, agosto-settembre, p. 51.
OBERT (G.). — Verso la marcia silenziosa dei treni. **giunzioni antimartellanti di rotaie.** (7 000 parole ig.)

---

946 623 (.45) & 624 (.45)
egneria ferroviaria, agosto-settembre, p. 69.
ipristino del ponte sul Po presso Piacenza. (1 200 ole & fig.)

L'Ingegnere. (Milano.)

946 62. (01 & 669 .1
ngegnere, maggio, p. 335.
ESTERO (G.) & PARIGI (R.). — **Metallografia tturale degli acciai.** (4 500 parole & fig.)

---

946 625 .13 (.45)
ngegnere, giugno, p. 450.
ANSONI (R.). — **Consolidamento di murature lesio-e.** (2 000 parole & fig.)

---

946 624 .92 (.45)
ngegnere, luglio, p. 513.
NDACO (F.). — **Strutture a traliccio tubolare.** (2 000 ole & fig.)

Ricerca scientifica e ricostruzione. (Roma.)

946 656 (.45)
rca scientifica e ricostruzione, maggio-giugno, p. 567.
AJOCCHI (U.). — Riattivazione, riorganizzazione e **dinamento dei trasporti pubblici** in Italia. (4 000 ole.)

---

946 621 .132 .8 (.45) & 621 .438 (.45)
rca scientifica e ricostruzione, agosto, p. 1099.
ARTINUZZI (F.). — L'attuale problema ferroviario ano e le **locomotive a turbina a combustione interna.** 00 parole.)

---

946 625 .11
rca scientifica e ricostruzione, agosto, p. 1137.
UGGERI (D.). — Redazione grafica dei **progetti dali e ferroviari.** (1 500 parole & fig.)

Rivista tecnica delle Ferrovie italiane. (Roma.)

1941 385 .57 (.45)
Rivista tecnica delle ferrovie ital., 15 dicembre, p. 469.
DRAGOTTI (G.) & FANELLI (M.). — I **controlli psicotecnici** del personale ferroviario. (6 000 parole & fig.)

1942 621 .335 (.45)
Rivista tecnica delle ferrovie ital., 15 gennaio, p. 5.
MINUCCIANI (G.) & ZATTONI (T.). — Esercizio con **locomotive elettriche condotte da un solo agente** sulla rete F. S. (7 200 parole & fig.)

1942 621 .431 .72 (.45)
Rivista tecnica delle ferrovie ital., 15 gennaio, p. 15.
GRAZZINI (M.). — **Locomotive Diesel elettriche** per ferrovie a scartamento di metri 0,950. (3 500 parole, 2 tavole & fig.)

1942 624 .2
Rivista tecnica delle ferrovie ital., 15 gennaio, p. 23.
D'AMATO (F.). — Le linee d'influenza delle caratteristiche della sollecitazione in una sezione generica di una **trave solidale con i piedritti.** (1 300 parole & fig.)

1942 656 .254
Rivista tecnica delle ferrovie ital., 15 febbraio, p. 41.
FIACHETTI (M.). — **Ripetizione in locomotiva dei segnali** della via. (18 000 parole & fig.)

1942 662
Rivista tecnica delle ferrovie ital., 15 febbraio, p. 68.
TOSTI (L.). — Il **metano** e la sua utilizzazione nei motori di trazione. (6 000 parole & fig.)

1942 621 .332
Rivista tecnica delle ferrovie ital., 15 marzo, p. 86.
DONATI (F.) & DE NICOLA (P.). — Prove comparative su **corde per trazione elettrica.** Calcolo delle tabelle di tesatura dei conduttori portanti della linea di contatto 3 000 V. C. C. (4 000 parole, tabelle & fig.)

1942 625 .15
Rivista tecnica delle ferrovie ital., 15 marzo, p. 100.
DE GIORGI (G.). — Le **comunicazioni fra binari.** (4 800 parole, tabelle & fig.)

1942 662 (.45)
Rivista tecnica delle ferrovie ital., 15 aprile, p. 117.
CUTTICA (A.). — **Impiego di metano sulle automotrici** delle Ferrovie dello Stato. (4 000 parole & fig.)

1942 625 .113
Rivista tecnica delle ferrovie ital. 15 aprile, p. 124.
RIGGIO (A.). — Su alcuni miglioramenti da apportare all' ingresso ed all' uscita dei **raccordi lineari della sopra-elevazione** e sulle conseguenti modifiche ai correspondenti raccordi planimetrici cubici. (2 000 parole & fig.)

1942 385. (09 (.62)
Rivista tecnica delle ferrovie ital., 15 aprile, p .128.
ROBBA (F.). — L'Egitto e le sue **vie di comunicazione.** (5 000 parole, tavole & fig.)

1942 621 .392 (.45) & 625 .245 (.45)
Rivista tecnica delle ferrovie ital., 15 maggio, p. 153.
DEL GUERRA (G.). — **Carri-serbatoio** per propano e butano liquefatti con serbatoio interamente saldato. (2 400 parole & fig.)

1942 **621 .331 (.45) & 725 .3 (.45)**

Rivista tecnica delle ferrovie ital., 15 maggio, p. 159.

DE ROSA (G.). — **Fabbricati per trazione elettrica.** Criteri costruttivi di progetto per **sottostazioni** ed alloggi del personale. (7 500 parole & fig.)

1942 **625 .251**

Rivista tecnica delle ferrovie ital., 15 giugno, p. 185.

MONTELUCCI (R.). — Grafici per **tabelle di frenatura** dei convogli. (3 000 parole & fig.)

1942 **656 .211 .5 (.494)**

Rivista tecnica delle ferrovie ital., 15 giugno, p. 190.

BAGNOLI (F.) & RUGGIERI (R.). — Gli **impianti di diffusione sonora e di segnalazioni ottiche** al pubblico presso le Ferrovie Federale Svizzere. (6 000 parole, tavole & fig.)

1942 **621 .336**

Rivista tecnica delle ferrovie ital., 15 luglio, p. 221.

DE NICOLA (P.). — **Condutture di contatto a corrente continua.** Perfezionamenti ed economie. (1 500 parole, 2 tabelle & fig.)

In Dutch.

Spoor- en Tramwegen. (Utrecht.)

1942 **656 .222 .1**

Spoor- en Tramwegen, Nr 23, 7 November, p. 429.

Snelheden op buitenlandsche Spoorwegen. (2 500 woorden & fig.)

1942 **656 (.45)**

Spoor- en Tramwegen, Nr 24, 21 November, p. 449.

Regeling van het wegvervoer in Italië. (2 300 woorden.)

1942 **625 .234 (093 (.492)**

Spoor- en Tramwegen, Nr 25, 5 December, p. 465.

MULDERS (J.-F.). — De **geschiedenis der Nederlandsche reizigerstarieven** 1940-1942 (Zie ook 1911-1917, Sp. & T. 17/31 Dec. 1935, p. 612; Tydens den Wereldoorlog, 3 Maart 1936, p. 108; Na den Wereldoorlog, 18 Aug. 1936, p. 404; 1922-1936, 9 Nov. 1937, p. 517; 1937-1939, 12 Oct. 1940, p. 424). (1 400 woorden en tafel.)

1942 **621 .43**

Spoor- en Tramwegen, Nr. 26, 19 December, p. 481.

HARDEMAN (W.-F.-K.). — Nieuwe ontwikkelingen van **verbrandingsmotoren.** (1 200 woorden & fig.)

1943 **621 .13 (093 (.92)**

Spoor- en Tramwegen, Nr 1, 2 Januari, p. 1; Nr 2, 16 Januari, p. 22.

BROUWER (K.). — De ontwikkeling van het **stoomlokomotiefpark** bij de Staatspoorwegen op Java. (3 500 woorden & fig.) (wordt vervolgd.)

1943 **388 & 656 .21**

Spoor- en Tramwegen, Nr 1, Januari, p. 6.

VAN MOURIK (Ing. W. J .G.). — De **ligging van het station** in de stad. (1 000 woorden & fig.)

1943 **654 & 656 .2**

Spoor- en Tramwegen, Nr 4, 13 Februari, p. 51.

FRANCKEN (A.-W.). — Iets over de **optische te**
graphie in het algemeen en haar toepassing bij de Spo
wegen. (2 300 woorden & fig.)

1943 **656 .222 (.42 + .43 + .49**
[& 656 .25 (0 (.42 + .43 + .49

Spoor- en Tramwegen, Nr 5, 27 Februari, p. 67; Nr 13 Maart, p. 86; Nr 7, 21 Maart, p. 101.

VAN WYK (H. P. D.). — Het **dienstreglement le der treinen** vergeleken met het vorige en twee buitlandsche voorschriften. (10 000 woorden & fig.)

1943 **385 (09 (.93**

Spoor- en Tramwegen, Nr 5, 27 Februari, p. 74.

FRANCKEN (A. W.). — Nieuw-Zeelandsche **spoorandere genoegens.** (5 000 woorden & fig.)

1943 **388 (.4**

Spoor- en Tramwegen, Nr 6, 13 Maart, p. 83.

VAN WEEL (Drs. J. R.). — De **stedelijke verkeemiddelen,** hun prestaties in heden en toekomst. (2 woorden & fig.)

1943 **621 .431 .72 (.494) & 621 .438 (.49**

Spoor- en Tramwegen, Nr 7, 27 Maart, p. 99.

Een **gasturbinelocomotief.** (1 200 woorden & fig.)

1943 **38 (.6) & 656 (**

Spoor- en Tramwegen, Nr 7, 27 Maart, p. 106; Nr 10 April, p. 123; Nr 9, 24 April, p. 138; Nr 8 Mei, p. 156.

Afrikaansche verkeersproblemen. (10 000 woor & fig.)

1943 **656 .256 (.49**

Spoor- en Tramwegen, Nr 8, 10 April, p. 115.

ROMBACH (W. R.). — Bij het verdwijnen der laat **mechanische blokstoestellen.** (3 000 woorden & fig.)

1943 **621 .13 (09 (.49**

Spoor- en Tramwegen, Nr 9, 24 April, p. 131; Nr 8 Mei, p. 152; Nr 11, 22 Mei, p. 171; Nr 12, 5 Ju p. 187; Nr 13, 19 Juni, p .200.

KARSKENS (J. J.). — De **locomotieven** met na van de H. IJ. S. M. (10 000 woorden & fig.)

1943 **656 .225 (.49**

Spoor- en Tramwegen, Nr. 9, 24 April, p. 134.

BOOGAARD (C.). — Credietverleening en enk andere **expeditie-faciliteiten** bij de N. S. (4 000 woorde

In Portuguese.

Gazeta dos Caminhos de ferro. (Lisboa.)

1946 **621**

Gazeta dos Caminhos de ferro, nº 1410, 16 de Setemb p. 651.

VIEIRA DE CASTRO (A.). — **Tracção eléctr** (2 500 palavras.)

M. Weissenbruch Co., Ltd., Printer of the King, 49, rue du Poinçon, Bruxelles.